POWER

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An Opportunity *for the* Engineering Profession

"Everywhere we look we see the products of engineering."

THE foregoing might well be taken up as a slogan for engineers. Yet, in spite of this ever present reminder of their work, engineers as a class figure little in public affairs and, with few exceptions, in directing large enterprises. Many are well up the ladder, but few are at the top.

Various explanations for this have been offered. Some attribute it to the engineer's training, which teaches him to think along concrete lines; others have sought to blame his modesty and lack of self-advertisement; while a few have even questioned his claim to such aspirations.

That a man, because he is an engineer, should be more modest or retiring than another who happens to be a lawyer or a business man, may seem incredulous, for it will be argued that this is a matter of personal disposition; yet it is a fact that the lawyer and, to a lesser extent, the business man, are accustomed to come forward with their views and argue their cases, which habit tends to cultivate aggressiveness and often leadership.

Engineers in general are to be found more as employees than as directors of work for which by training they are eminently fitted; and as such the very nature of their occupations tends to restrict their opportunities to certain channels and divert their attention from the broader problems.

The war brought about public recognition of engineering accomplishments. There was need of something to sustain and capitalize such recognition. Individually, engineers could do little, but collectively, the opportunities were without limit. There was a general demand from the ranks that action be taken, and the movement, which has been gaining momentum for the last two years, has crystallized into the Federated American Engineering Societies, which held its founder meeting last May. Since that time engineering societies all over the country have signified their intention of joining in this great co-operative effort for public service.

The second meeting of the Federation is to be held in Washington on November 18, at which time plans will be formulated for concrete action. The program will be found elsewhere in this issue.

The influence of such an undertaking cannot be overestimated, and it behooves every engineer to throw his hearty support into the work through the channels of his local society.

New Northeast Station at Kansas City

One of the latest high-pressure stations with plans calling for an ultimate capacity of 270,000 kw. It is featured by combination high-and low-pressure economizers, submerged ashpits, vertical condensers with hydraulic vacuum nozzles, a ring bus system and a number of other features new on the electrical end.

A STRICTLY modern power station to supply efficiently power and lighting for Kansas City, Mo., and the surrounding territory has been needed for years. The three older plants serving the city had become inadequate, and during the war period a new plant of ample capacity became imperative even in the face of high prices and the adverse manufacturing conditions existing at the time. A level tract of land on the Missouri River, with good railway and water facilities was chosen as the site. Construction began in 1917 and has been continued as rapidly as possible. As the property was low and made up for the most part of sand and silt deposits, all foundations were sunk to bedrock and provisions made to take distribution lines out overhead. Sand has been pumped from the river bed so as to bring the ground above high water, and a levee has been built along the river bank to fully protect the site.

Reference to the property plat shown in Fig. 1 will indicate the tentative layout of the station. The plan shows four unit groups with a condenser well for each and two intake wells for the four. The first group unit is to consist of three 20,000-kw. machines, two of which have been installed and put in operation; the third is now being erected. Each of the other three condenser wells is to serve two 35,000-kw. machines, so that the ultimate intention is to have four units made up of nine machines having an aggregate capacity of 270,000 kw. The general layout shows the transmission lines coming out on the river side of the station, a coal-storage yard on the opposite side and railway tracks leading to each department of the plant for handling coal and ashes and the mechanical equipment. The layout is self-explanatory, and it is evident that there is still room for extension above the ultimate capacity planned.

The outstanding features of the plant are a special arrangement of high- and low-pressure economizers, a steam temperature of 675 deg. made up from an operating pressure of 300 lb. gage and superheat of 250 deg. F., chain-grate stokers 17.5 ft. long, submerged ashpits, vertical condensers placed in a pit to meet the great changes in river level, and a number of new features on the electrical side. A study of Figs. 8 and 9 will disclose the general arrangement of the initial installation, and the accompanying table will give the sizes and relative proportions of the equipment serving the two machines now in operation. At 80 per cent power factor each of these machines is rated to develop 20,000 kw.; making 40,000 kw. for the initial installation. Three-phase 60-cycle current is generated at 13,200 volts. The two machines first installed are served by six boilers, each having 13,512 sq.ft. of steam-making surface and a maximum generating capacity of 110,000 lb. of steam per hour. With the addition of the third machine two more boilers are being installed. It is the expectation that, normally, seven boilers will carry the three turbines, leaving one boiler in reserve. This is a provision of 1.576 sq.ft. of steam-making surface per kilowatt, or an allowance of 6.3 kw. to the boiler-horsepower.

The eight boilers are arranged four on either side of a central firing aisle, with the high- and low-pressure economizers above the boilers and induced-draft fans between the economizers and the smoke flue. Each pair of boilers is served by a steel stack 10 ft. diameter and 126 ft. high above the boiler-room floor. Individual overhead coal bunkers having a capacity of 125 tons, or a 24-hr. supply, are placed over the central firing aisle, on either side, with a skylight between, and below is a concrete coal-storage pit containing the

coal crushers with a capacity of 820 tons per boiler, sufficient for a six-day run at normal capacity. This arrangement calls for an exceptionally high building. To allow coal cars to come in at ground level below the unloading crane, the boiler-room floor is 30 ft. above the ground and 70 ft. below the roofs covering the boilers and economizers. An innovation is a submerged ashpit, into which the ashes drop directly from the stokers, this forming a seal and doing away with the slope of the boiler upward, a furnace volume of 3,100 cu.ft. has been provided. This reduces to 8.9 cu. ft. per square foot of active grate, and when burning coal at the maximum rate obtainable with induced draft, about 45 lb. per hour per square foot of grate, the furnace volume per pound of coal becomes approximately 0.2 cubic foot.

Except for their unusual size the stokers are standard, but of heavy construction. There are two

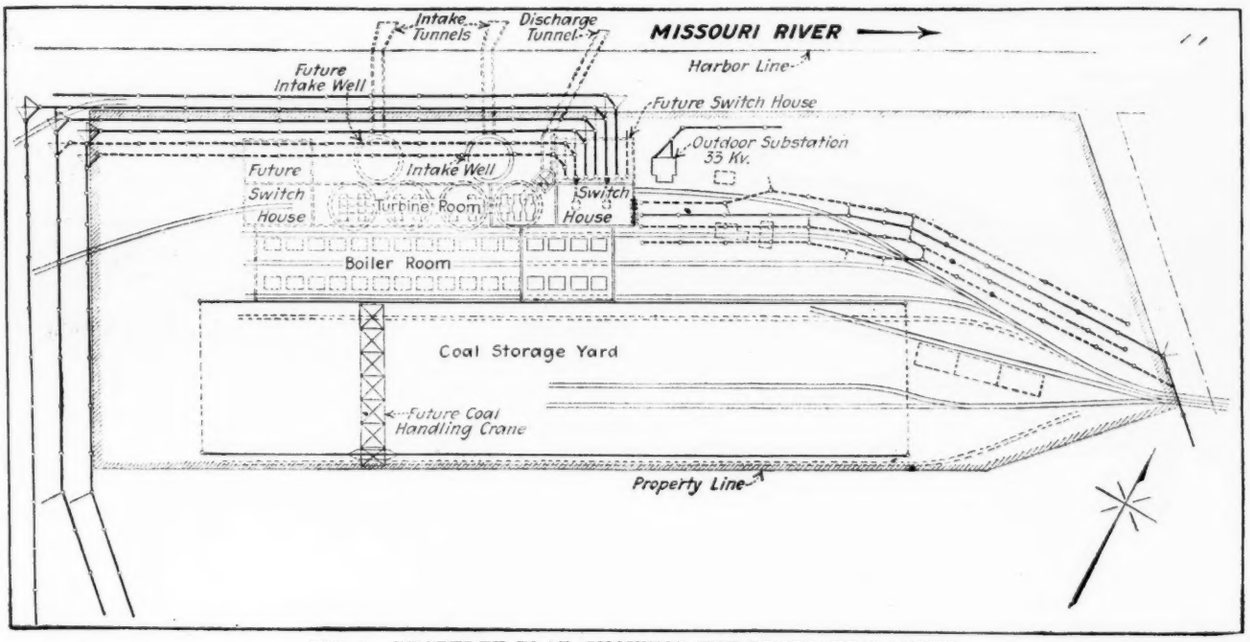


FIG. 1. PROPERTY PLAT, SHOWING THE PROPOSED LAYOUT

the usual spray pipes. The ashes are transferred from the pits by traveling cranes equipped with grab buckets to railway cars also operating at the ground level. It will be understood that the incoming coal is transferred by the traveling crane either to storage or directly to the crushers and thence overhead to the bunkers by means of the continuous bucket conveyors shown with their lower runs under the crushers. Reference to the vertical section of the plant will show that the boilers are of the cross-drum type, with the stokers under the low end and the rear wall of the setting drawn in to meet the bridge wall. Inspection doors at this point allow the fuel bed to be inspected or sliced when necessary. To facilitate the removal of slag and soot, drop legs continued from the tube headers place the first row of tubes 21 in. center-to-center below the second row. With the bottom of the mud drum below the front tube header 10 ft. above the floor line and per boiler, each 10 ft. wide and 17.5 ft. long, giving an active grate area of 350 sq.ft., which bears a ratio to the steam-making surface of 1 to 38.6. Burning the coals of Kansas and occasionally the semi-lignites of Arkansas requires a grate of large proportions if the boiler is to operate at high capacity. The stokers are designed to operate at speeds ranging from 2 to 11 in. per minute, allowing a wide margin for variation in thickness of fuel bed or in rate of travel to suit the time element established by the quality of the coal being burned. The stokers are driven by belt from a lineshaft which is turned either by an engine or a motor, both on the boiler-room floor and one of each for each row of four boilers.

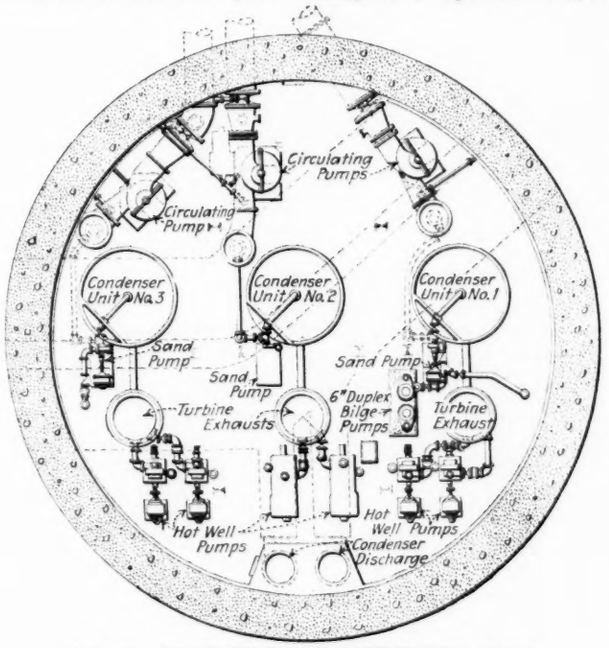


FIG. 2. PLAN OF FIRST CONDENSER WELL

Previous mention of the economizers has been made in *Power*.* High operating pressure and corrosion from the condensation of vapors in the flue gases were the two factors determining the

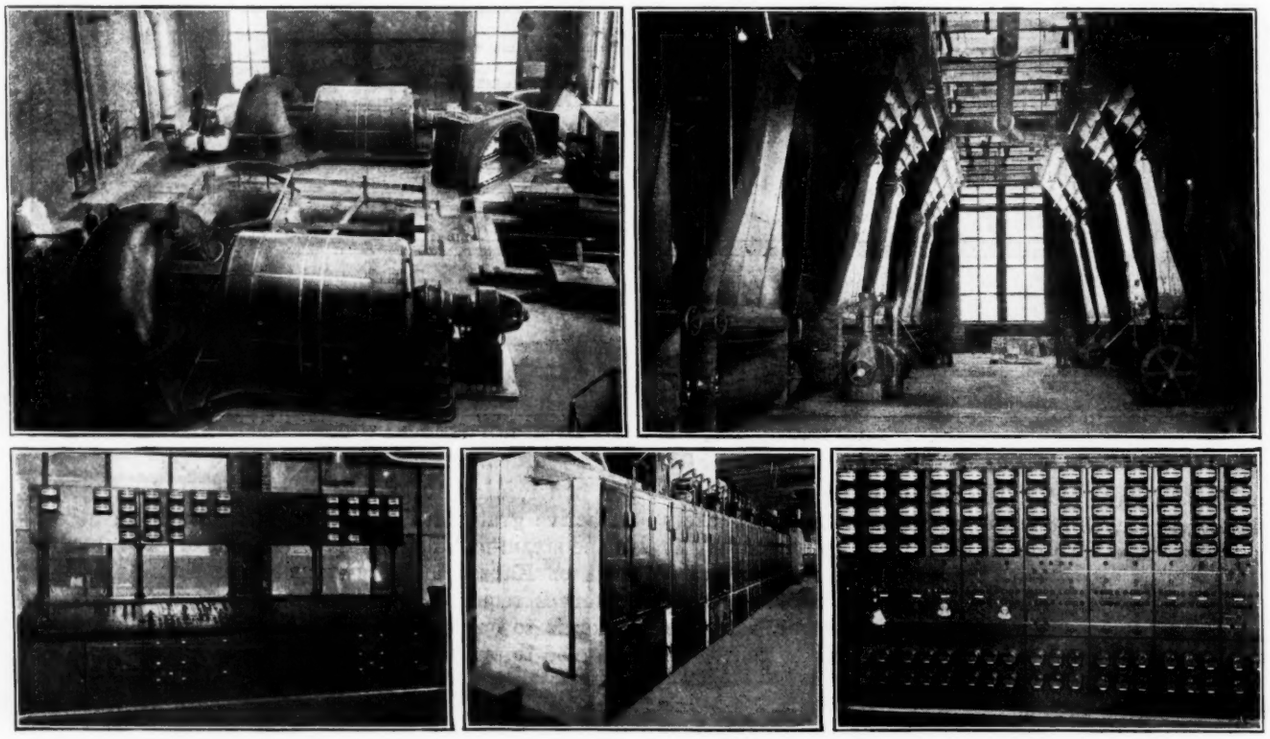
*Issue of April 15, 1919, pp. 556-7.

division of the economizer into two sections—one a high-pressure section made of steel to better withstand the pressure, and the other a standard low-pressure cast-iron economizer to resist the corrosion from the condensed vapors. The former resembles a section from a Stirling boiler. It is located immediately above the boiler outlet, contains about one-third as much surface as the boiler proper and is baffled for three passes of the gases. The elements of the low-pressure section have 4,838 sq.ft. of surface, as compared to 4,205 sq.ft. for the hotter part of the economizer and 13,512 sq.ft. for the boiler. The proportions are such that the water in the cast-iron section is heated to something less than 200 deg. F., say 170 to 190 deg., which will prevent the formation of steam and put the water into the high-pressure section at a temperature sufficiently high to prevent condensation on the tubes and the resulting corrosion.

pure steam and water drains and a supplementary supply from deep-well pumps to maintain the water level. Deep-well pumps also supply the house service, the muddy river water being used only for condenser cooling purposes.

In the steam-piping layout the long expansion bends will be evident. The piping is extra-heavy, steel fittings are employed and the high-pressure joints are welded to make them steamtight.

Reference to the plan view of the station will show that the turbine-room floor is practically clear of auxiliary machinery, the only machinery in addition to the main units being the turbine-driven exciter. These machines have a rating of 20,000 kw. at 80 per cent power factor. Three-phase 60-cycle current is generated at 13,200 volts. In the city current is distributed at this voltage, but for outlying districts the supply



FIGS. 3 TO 7. VIEWS OF TURBINE AND BOILER ROOMS, BENCHBOARD, FEEDER PANELS AND AUXILIARY POWER-DISTRIBUTING PANELS

The gases are drawn through the economizer sections by two induced-draft fans driven by a slip-ring induction motor with numerous points on the controller giving a range in speed of about 2 to 1. The controllers are located on the main floor near the boiler fronts.

Feed water is largely condensate discharged by the hotwell pumps through a closed feed-water heater, one for each condenser, into the cool compartment of an immense feed tank mounted over the boilers. Motor-driven pumps then force the water through the low-pressure section of the economizer, from which it runs by gravity into the hot compartment of the feed tank. From the latter turbine-driven boiler-feed pumps take their suction and force the water through the high-pressure steel economizer into the boiler. There will be six of these pumps for the eight boilers.

Makeup water under float control comes into the hot compartment of the feed tank from a large concrete tank below the basement floor. This tank receives all

is stepped up to 33,000 volts in an outdoor substation located on the premises. The machines have direct-connected exciters, and in reserve there is a separate steam-turbine reduction-gear unit rated at 200 kw. Each main generator is also provided with an air washer to clean and cool the air used for ventilation.

All condensing equipment is located in a well 70 ft. in diameter and 57 ft. deep below the turbine-room floor. Each turbine is served by a condenser of the vertical two-pass type containing 35,000 sq.ft. of surface in 1-in. tubes 18 ft. long, the steam-condensing capacity being 225,000 lb. per hour, which reduces to 6.4 lb. of steam per square foot of surface. A vertical exhaust pipe 12 ft. in diameter extends from each turbine to the bottom of the well. Exhaust steam enters the condenser through an opening extending practically the full height between the tube plates. Condensation from the turbine and the exhaust pipe collects in the hotwell at the bottom of the latter, and

the condensation from the condenser drains to this same hotwell. From here the hot water is taken by either one of two condensate pumps, one a reserve, and is passed through preheating tubes shut off from the condenser, to the feed tank in the boiler room.

Circulating water enters at the top of the condensers and leaves at the same level at the opposite side. It is supplied by a vertical volute pump drawing from the river. As the water carries a great deal of suspended matter, a sand pump has been provided for each condenser to remove any accumulation that may collect in the bottom head.

Air is removed from each condenser by three 10-in. hydraulic nozzles, the water for operating these nozzles being supplied by two motor-driven 10-in. centrifugal pumps connected in a closed circuit. The nozzles dis-

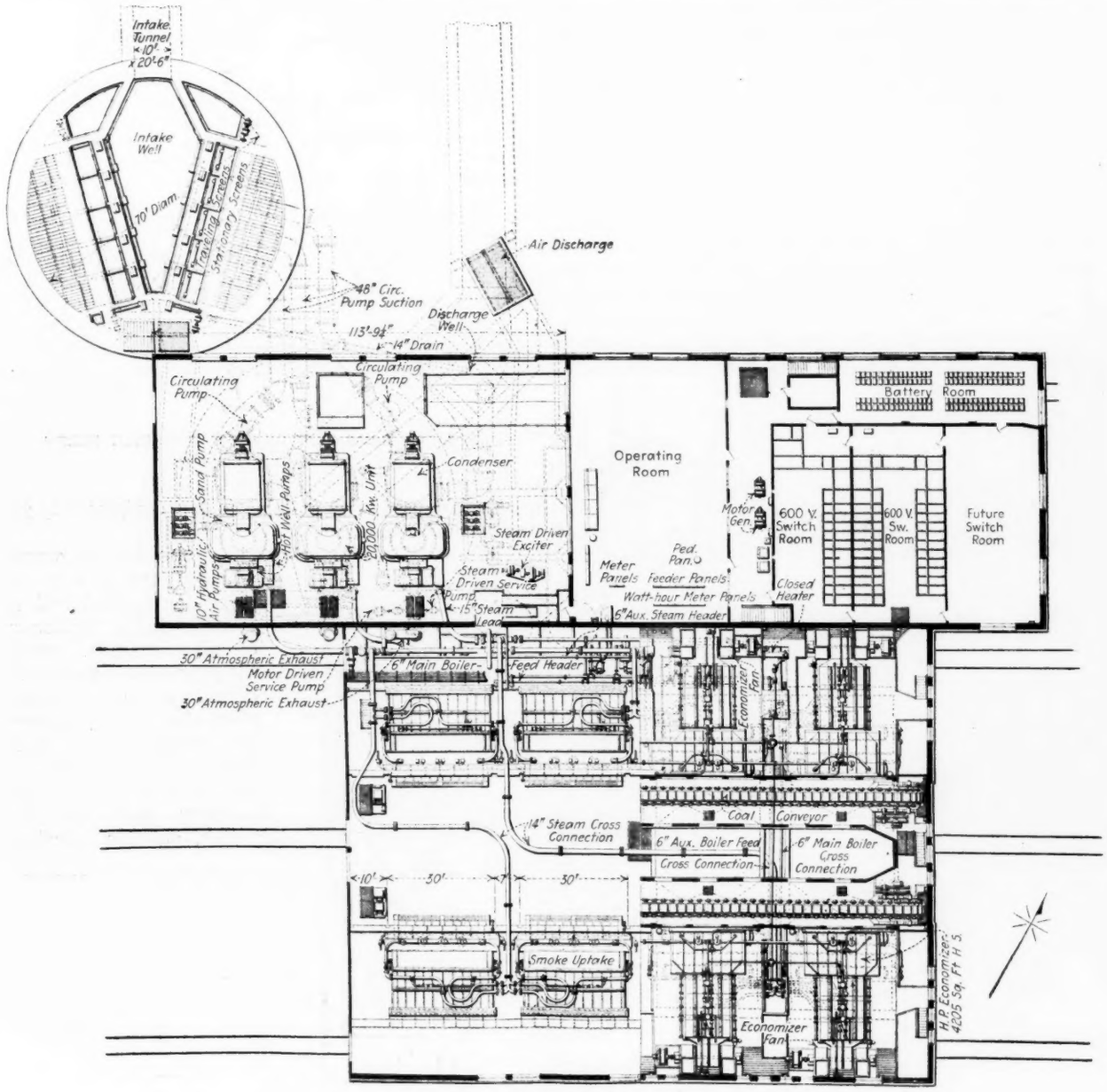


FIG. 8. GENERAL ARRANGEMENT PLAN OF STATION

the intake well at the rate of 35,000 gal. per min. It is driven at 514 r.p.m. by a vertical induction motor. The intake well, which is 70 ft. in diameter and 13 ft. deeper than the low-water level, serves two condenser wells. Water from the river enters the center of the well, and from one side water is drawn off to the three units under discussion. It passes through a bar-iron grill, then through traveling screens, and finally through stationary screens before entering the 48-in. main leading to each circulating pump. Discharge water leaves the station by means of a tunnel to a point down charge into a tank cooler in which the air is liberated and the water is again taken by the pumps and forced through the nozzles. To keep the supply of water cool, a sufficient amount of water from the deep-well supply is admitted to maintain the required temperature. Fig. 2 is a plan view showing the arrangement of the condenser equipment in the well.

On the electrical end a ring bus system is employed. Fig. 10 shows the plan as it is drawn up for the first two unit divisions of the plant, consisting of five machines. As the diagram shows, these five machines

are connected to the one ring bus. Each generator supplies its particular section of the bus and the corresponding feeders. Between each unit is a 5 per cent bus reactance with a short-circuiting switch so interlocked with the generator switch that it will close when the latter opens and cut out the reactance, and vice versa, when the generator switch closes, the short-circuiting switch is automatically opened. Owing to this provision only one reactance can intervene between running generators, and the voltage troubles that might ensue if the current from one section of the bus should pass through several reactances in series, are eliminated. Three per cent reactors are introduced in the feeder circuits.

Fig. 11 is a single-line diagram showing the electrical layout. Current from each main unit is fed at the generator voltage of 13,200 volts, into either its respective main bus or the reserve bus. The latter is not of the ring type and has no bus reactances, although it does have the sectionalizing switches. As previously stated, each section of the main bus is supplied by its respective generator and has a definite number of feeder circuits. In addition each division supplies through an 1,800-kva. transformer a 600-volt alternating-current bus for the auxiliary motors belonging to

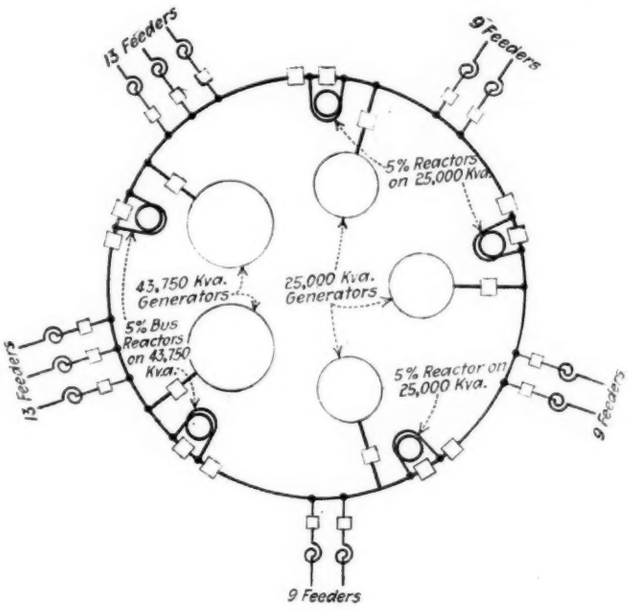


FIG. 10. RING BUS SYSTEM FOR THE FIRST FIVE MACHINES

motors are used, with suitable control equipment to give the variation desired.

Differential relays actuated by two sets of current transformers, one at the generator neutral and the other at the generator oil-circuit breakers, protect the generator-armature circuit. In case of grounds or short circuits in the generator windings or leads, these relays open the main and neutral oil circuit breakers and the field switch, suitable interlocks

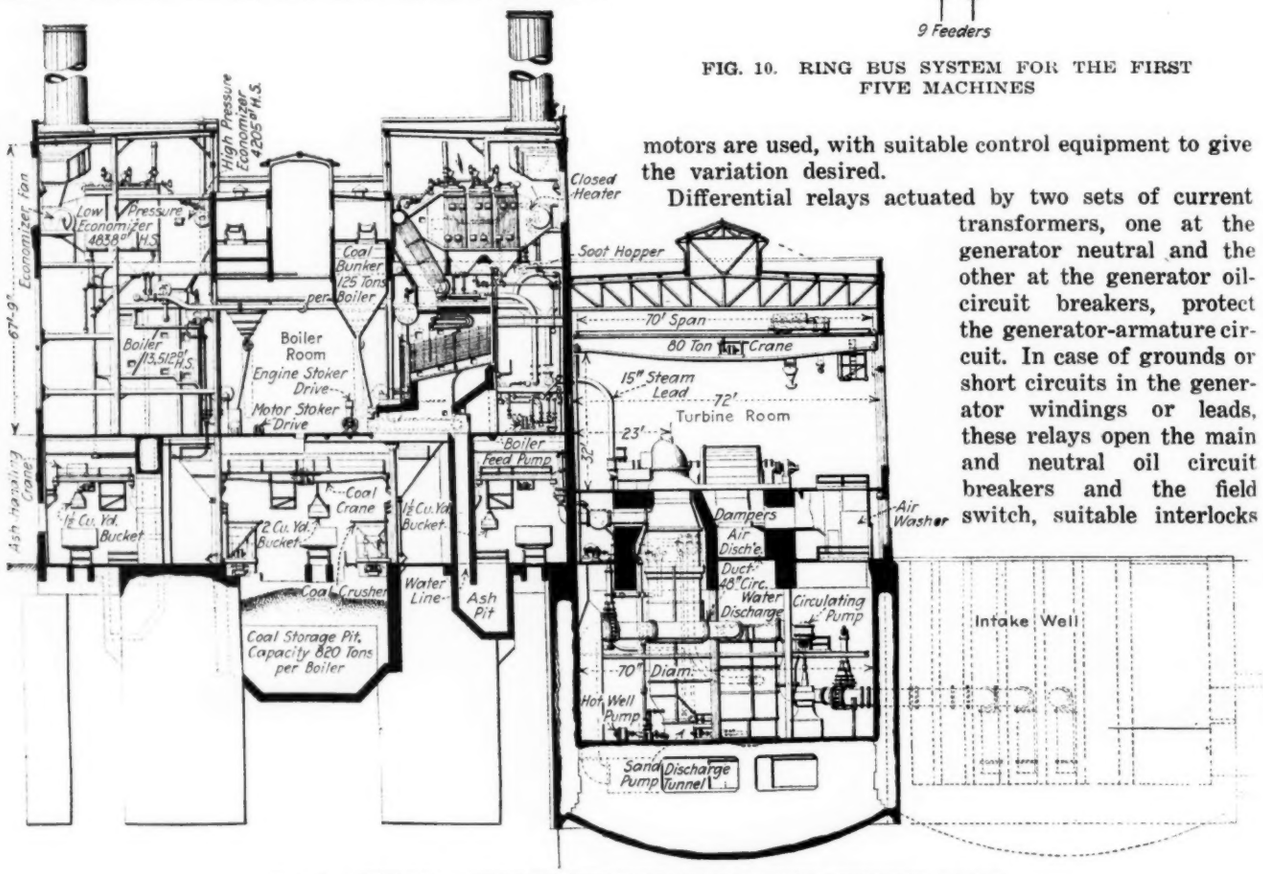


FIG. 9. VERTICAL SECTION THROUGH BOILER AND TURBINE ROOMS

the particular units in question. To take care of the various station motors which are used in common for the entire station, driving supply pumps, cranes, etc., another 600-volt bus has been provided, and in addition there is an emergency 600-volt bus fed by a reserve transformer, which may be thrown onto any one of the aforementioned low-tension busses in the event that their respective transformers are out of service. The station auxiliary service is alternating-current three-phase 60-cycle induction motors, both slip-ring and squirrel-cage type being employed. Where the service requires variable speed, slip-ring induction

being used to insure the proper sequence of operation. The respective generator neutrals are connected to the neutral bus through single-pole oil circuit breakers, and the bus itself is permanently connected to ground through resistance.

With the exception of the neutral breakers all generator circuit breakers are of the triple-pole single-throw type. All 13,200-volt oil circuit breakers are motor-operated. The generator neutral circuit breakers

and all 600-volt auxiliary feeder oil circuit breakers are of the solenoid-operated type, and this applies also to the generator field and exciter switches. The larger auxiliary motors such as are employed to drive the circulating pumps, hotwell pumps, etc., are fed directly from 600-volt oil circuit breakers in the switchhouse. The smaller auxiliary motors are fed from inclosed-fuse, lever switches of the safety type. These switches are arranged in groups, being fed from busses supplied through 600-volt oil circuit breakers in the switchhouse. Some idea of this new departure in station

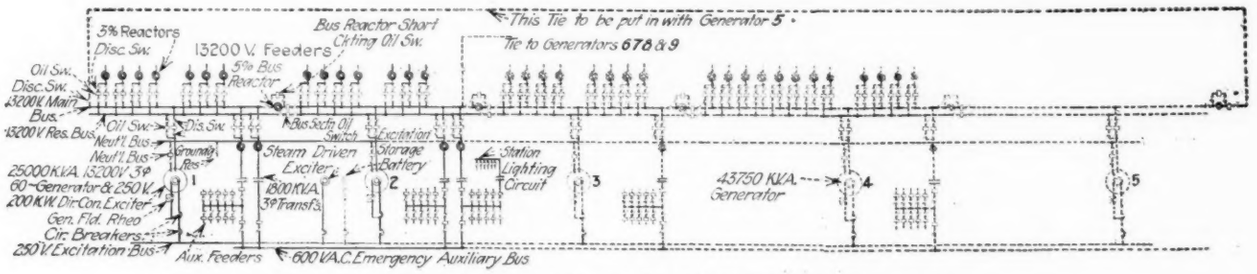


FIG. 11. SINGLE-LINE FLOOR DIAGRAM OF ELECTRICAL LAYOUT

auxiliary distributing panels may be obtained from Fig. 13.

As indicated in the plan view of the stations, the switchhouse is located at one end of the turbine room. This structure will serve the first two unit divisions of the plant, and a similar switchhouse at the opposite end of the station will serve the remaining units when installed. Fig. 12 will show that the switchhouse has three floors. The operating room for the entire station is on the top floor overlooking the turbine room. On

such a station have been installed on the bench and switchboards. There are standard signal systems between the benchboard and each unit, consisting of an eight-circuit signal box with push-button switches and lamps with lenses lettered for the different operations. A duplicate box with a signal bell to attract attention is mounted on each turbine-room gage board, and here, too, is an indicating wattmeter to show the load on the machine. A duplicate instrument is placed on the boiler-room gage board so that both turbine-room operators and the

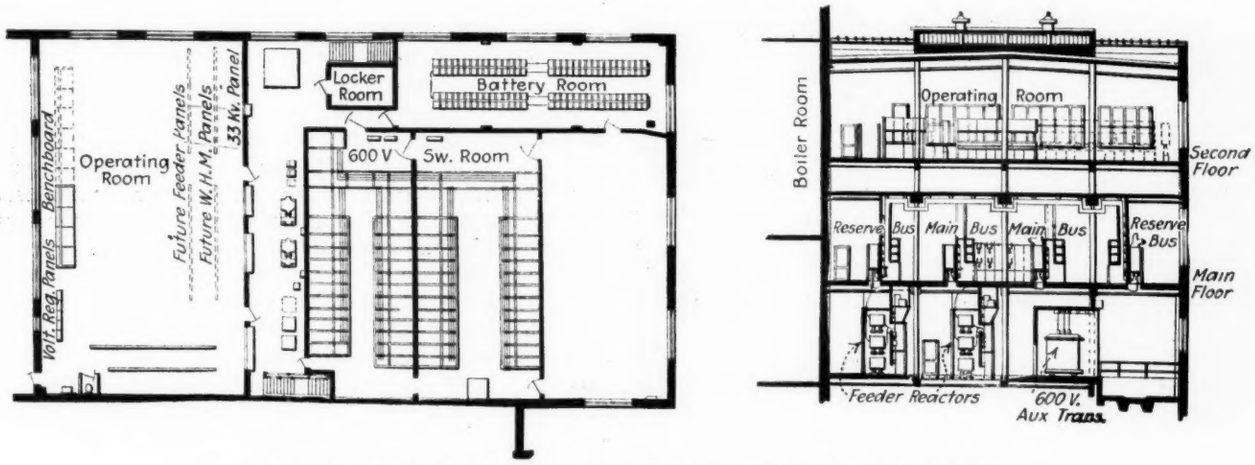


FIG. 12. SECOND-FLOOR PLAN AND ELEVATION OF SWITCHHOUSE

the same floor are the storage batteries, consisting of two 125-volt 62-cell units connected in series with three-wire connections to give 125 volts for switch control and 250 volts for emergency lighting or excitation. Space has also been allotted to the 600-volt auxiliary feeder circuit breakers which are mounted on open, pipe framework with fire walls between every two groups of breakers. Underneath is a conduit floor principally for the control and the stationary auxiliary feeder cables. The first floor of the switchhouse contains the 13,200-volt bus structure and the oil circuit breakers, as well as exciter and field switch panels. On

boiler force may know the exact load that is being carried. For convenience in operation all 600-volt auxiliary feeder oil circuit breakers are electrically controlled from panels on the turbine-room floor.

An interesting innovation is the system installed for generator fire protection. It consists of a pipe ring at either end of the machine inside of the end shield, with nozzles projecting from these circular pipes toward the stationary windings. The pipes are brought to the turbine-room wall at a distance from the machines, so that a hose connection can be easily and quickly made in case of fire.

Sargent & Lundy, consulting engineers, of Chicago, are responsible for the design and installation of the station. Joseph F. Porter is president of the Kansas City Power and Light Co., and H. C. Blackwell is

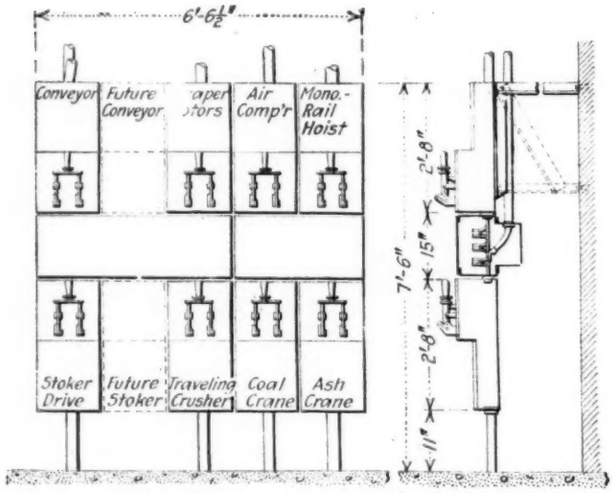


FIG. 13. CONCRETE BUS AND OIL-SWITCH COMPARTMENT

vice president and general manager. Edwin Jowett has charge of the operation of the station.

PRINCIPAL EQUIPMENT OF NEW KANSAS CITY PLANT—FIRST TWO UNITS

Boilers:	
Type	Water-tube, B. & W. cross-drum
Number installed	6
Steam-making surface, sq.ft.	13,512
Working pressure, lb. gage	300
Superheat, deg. F.	250
Superheater, B. & W., sq.ft.	3,863
Temperature steam, deg. F.	675
Capacity of each boiler, max. lb. steam per hour	110,000
Stokers:	
B. & W. chain grate, two per boiler, 10 ft. wide, 17 ft., 6 in. long, belt-driven from line shaft, one engine and one motor per four boilers	
Grate area, active, per boiler, sq.ft.	350
Capacity, max. lb., coal per hr.	18,000
Economizers:	
B. & W. high-pressure steel economizer, surface, sq.ft.	4,205
Green low-pressure cast-iron economizer, surface, sq.ft.	4,838
Fans:	
Green induced-draft, two per boiler, driven by one 150-hp. slip-ring induction motor, r.p.m.	600
Capacity, lb. gas per min. per boiler at 375 deg. F.	5,500
Stack:	
Steel	One per two boilers
Height above boiler-room floor, ft.	126
Diameter at top, ft.	10
Free area, sq.ft.	78.54
Boiler Ratios:	
Ratio grate area to steam-making surface	1 to 38.6
Ratio superheater surface to steam-making surface	1 to 3.5
Ratio surface in hp. econ. to steam-making surface	1 to 3.2
Ratio surface hp. econ. to steam-making surface	1 to 2.8
Stack area per 100 sq.ft. steam-making surface, sq.ft.	0.29
Breaching area per 100 sq.ft. steam-making surf., sq.ft.	0.36
Connected grate area per sq.ft. of stack	8.9
Pumps:	
Boiler feed, 4 Worthington, 4-stage, 4-in. cent. turbine-driven, capacity of each, g.p.m.	600
Service, 2 Worthington cent. one motor- and one turbine-driven, capacity of each, g.p.m.	850
Makeup, 2 yeomans, vertical, motor-drivers, capacity, g.p.m.	200
Deep well, 2 American Well Works, vertical volute, motor-driven at 1200 r.p.m., capacity of each, g.p.m.	700
Feed-Water Heaters:	
One per unit, closed type, Patterson-Kelley, cast-iron shell, copper tubes, capacity, lb. water per hr., from 75 to 120 deg. F.	250,000
Coal Storage:	
Overhead steel bunkers, one per boiler, tons	125
Pit under central aisle, tons per boiler	820
Cranes:	
Coal-handling, one Whiting, four-motor traveling type, 2-cu.yd. bucket, span, ft.	38
One locomotive crane, W. B. Lover Co., capacity, tons	15
Ash-handling, two Whiting four-motor traveling type, 1½-cu.yd. bucket, span ft.	18.2
Turbine room, one Whiting, four-motor traveling type, 80-ton hoist, 15 ton aux. hoist, span, ft.	70
Coal Crushers:	
Two four-roll traveling, Orton & Steinbrenner, cap. per hr., tons	125
Coal Conveyor:	
Two continuous-bucket, Link-Belt, cap. per hr., tons	125
Turbines:	
Two G.E. single-cylinder, horizontal, 23-stage	
Rating at 80 per cent. power factor, kw	20,000
Speed, r.p.m.	1,800
Operating pressure at throttle, lb. gage	250
Superheat, deg. F.	250
Net weight of unit, lb.	412,000
Weight per kw. of rating, lb.	20.6
Generators:	
Two G.E. three-phase, 60-cycle, 13,200-volt	
Rating at 80 per cent power factor, kw	20,000
Air for cooling, cu.ft. per min.	55,000
Air washer, one per unit, Sturtevant	
Exciters:	
One to each unit, direct-connected, 250-volt, kw	110
One spare, turbine-driven, reduction gearing, kw	200
Condensers:	
Two Worthington surface, vertical, two-pass, 1-in. tubes, 18-ft. long, surface, sq.ft.	35,000
Capacity of each to condense, lb. steam per hr.	225,000
Traveling screens for two machines, four, Chain Belt Co.	
Condenser Auxiliaries:	
Circulating pumps, Worthington, vertical volute, one per unit, cap., g.p.m.	35,000
Pump capacity per lb. steam, condensed, lb.	78
Driven by vertical induction motor, hp.	458
Speed, r.p.m.	514
Condensate pumps, two per unit, Worthington two-stage 5-in., capacity, g.p.m.	800
Driven by 177 hp. ind. motor, r.p.m.	1,200
Vacuum pumps, three per unit, Worthington hydraulic vacuum nozzles, supplied by two motor-driven 10-in. cent. pumps, cap. each, g.p.m.	3,200
Switchboard:	
G.E. design and equipment.	

Mine Hoist to Carry One Hundred Men

As in all other trades the working hours of the miner have been shortened. The time spent in lowering the men into the mines or hoisting them to the surface is thus a factor of increasing importance, as it represents a larger fraction of the working time and consequently has a corresponding influence upon the output. It is to the mines' interest, then, in particular where large bodies of men are employed, to provide larger and faster hoists, so that this item of loss may be held to a minimum.

It was with this idea in view that the United Verde Copper Co. ordered for its mine at Clarkdale, Ariz., a Nordberg man hoist of unusual proportions. The hoist, which is of the single-drum motor-driven type, is designed to operate in balance at a rope speed of 800 ft. per min. It has capacity to carry at one time 100 men, which is about three times the number usually handled. In addition to the large carrying capacity an unusual feature with this hoist is the provision of a reel, independent of the drum although keyed to the drum-shaft, for carrying the flat counterbalance rope.

The hoist has three main bearings, with a herringbone reduction gear between the drum and the motor, the latter being of the induction type rated at 350 hp. and having a speed of 345 r.p.m. The entire hoist weighs approximately 165,000 lb.. and the drum, which is 12 ft. in diameter, with a 6-ft face, weighs 65,000 lb. The drum has been designed to hold 2,500 ft. of 1⅜-in rope in two layers. Its shell is of rolled steel plate 1½-in. thick with cast-steel end rings. The spiders are cast separately and fastened to the end rings with turned bolts driven into reamed holes. The reel has a bottom diameter of 6 ft. and is 5⅞ in. wide to take a 5½-in. flat rope. The loading is approximately as follows:

Men, lb.	16,500
Empty double-deck cage, lb.	13,500
Two loaded cars ore cars, lb.	12,000
2500 ft. 1⅜-in. rope, lb.	12,200
Maximum cable pull, lb.	42,200
Counterweight, lb.	30,000
2100 ft. ⅜ x 5½-in. flat rope, lb.	8,800

The hoist is provided with one set of brakes of the gravity post type, operating on a brake ring bolted to

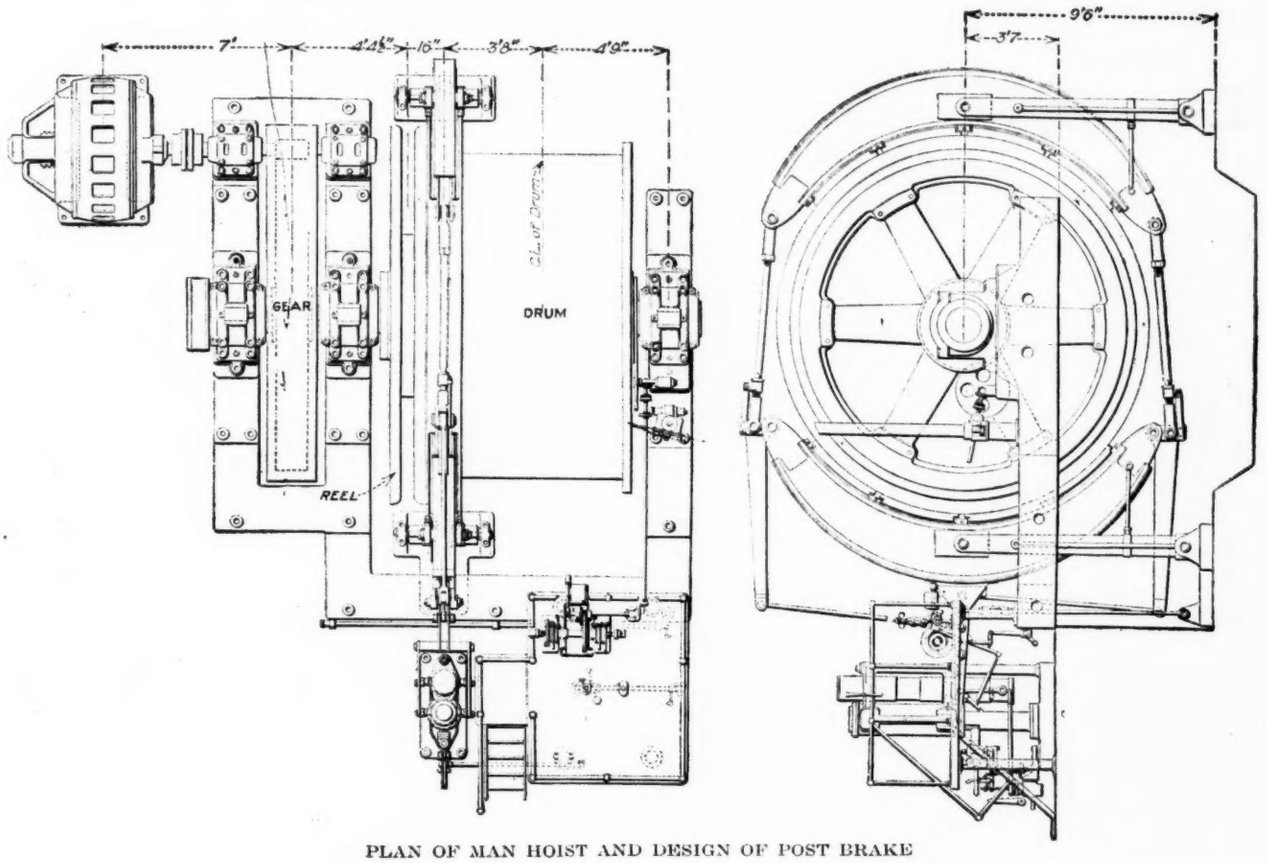
the drum. The brake itself consists of a pair of wood-lined brake posts supported on heavy carrier bolts to the bedplate. The posts are mounted so as to compel parallel motion when engaging or releasing. The tops and bottoms of these posts are drawn together by means of drawbars and forged steel levers, having turnbuckles for adjustment.

Control is effected hydraulically; the brake and clutch are operated by outside-packed plunger-type thrust engines using oil under pressure furnished by an accumulator. The oil is admitted to and exhausted from these thrust cylinders by balanced poppet-type hydraulic valves operated by a system of floating levers arranged so that the plunger of the thrust engine follows the motion of the operator's lever. Whenever the operator's lever comes to rest, the plunger also comes to rest, and is locked in that position owing to the fact that both inlet and exhaust valves are closed. In this way the operator has full control of the brakes just as if he were operating them by hand.

The accumulator is of the direct-pressure loaded plunger type, consisting of a vertical hydraulic plunger and a loaded cylinder working on it. To the upper end of the cylinder is secured a cylindrical steel bucket arranged so as to bring its center of gravity as low as possible, the bucket being of sufficient size to hold the proper weight of sand or other material to balance the working oil pressure.

Two motor-driven triplex pumps, one unit acting as a reserve, supply the necessary oil for the operation of the brakes. Bypass valves, operated by the movable bucket, have been provided for bypassing the surplus oil. One of the most interesting features of the unit is a mechanically operated safety device provided to protect the operation of the hoist. At each trip the power is automatically shut off and the brakes automatically applied by means of cams driven from the drumshaft. The cams are constructed to give gradual operation of the brakes and insure the complete stopping of the hoist by the time the load reaches the top of the run. Should one of the clutches be disengaged and the load lowered on the brakes, the brakes will be applied gradually and the load brought to rest at the bottom of the descending trip. In case of overspeeding the brakes are applied, the current cut off and the hoist brought to rest. Any attempt to overwind or start the hoist in the wrong direction will result in the instant application of the brakes and the shutting off of the power.

All these operations take place every trip made by the hoist if the operator leaves the controller levers alone, but these features do not interfere if the operator takes control of the operating levers and wills to stop the hoist in the ordinary manner.



PLAN OF MAN HOIST AND DESIGN OF POST BRAKE

Owing to the Chinese fondness for things durable, giving good service a long time, electric-plant equipment of sterling quality, capable of withstanding untrained usage, is in strong demand now that electricity is coming into its own in China, comments the *North China Daily News*. Many orders have been given for power and lighting plant for cotton mills, and the demand for lighting plant for cities in the interior is steadily growing. Steam turbines are to the fore where large plant is concerned and they are being introduced to some extent in the smaller plants, since the advance in the price of crude oil.

Using the Indicator on a Diesel Engine

Unfortunately, the average Diesel engineer has no conception of the value of an indicator as a means whereby the valve setting may be properly checked. It happens that the Diesel operator is usually the product of an automobile repair shop and his experience has been almost entirely along automatic lines. The tendency to employ such men rather than steam engineers is practically universal. This is wholly the fault of the steam-engineering profession in that it has never seriously taken up Diesel engineering. The ex-automobile mechanic knows nothing of the indicator and attempts to set the valves by shop data. After an engine has been in operation for some time, the old shop data cannot be considered as dependable, since considerable backlash now exists. The indicator is the only means whereby faulty adjustment can be detected.

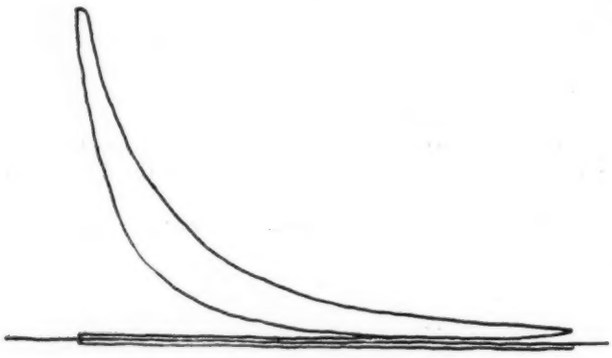


FIG. 1. LATE EXHAUST OPENING

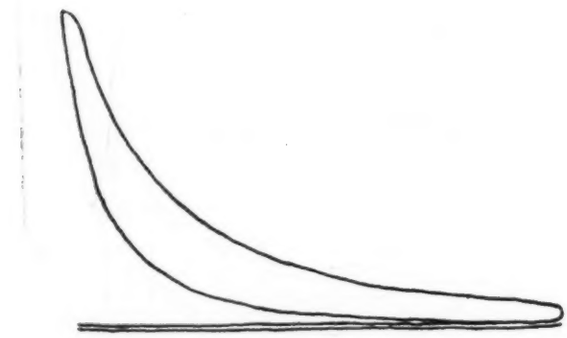


FIG. 2. CORRECT EXHAUST OPENING

As an example of faulty valve setting attention is called to Fig. 1. Here the exhaust valve opens extremely late and imposes a considerable back pressure on the piston. An engine having the valve opening so late will labor and show an inability to carry its load.

Fig. 2 is a diagram from the same engine after the exhaust-valve opening had been advanced. A light spring was not available, and as a result the point of valve opening is not so clearly indicated as is desirable. In this case, if the engineer had had an indicator and had used it, the engine would have been tuned up at once.

Every Diesel-engine plant should be provided with an indicator; if the management is unwilling to invest, it is money well spent even though the engineer must dig down into his own pocket.

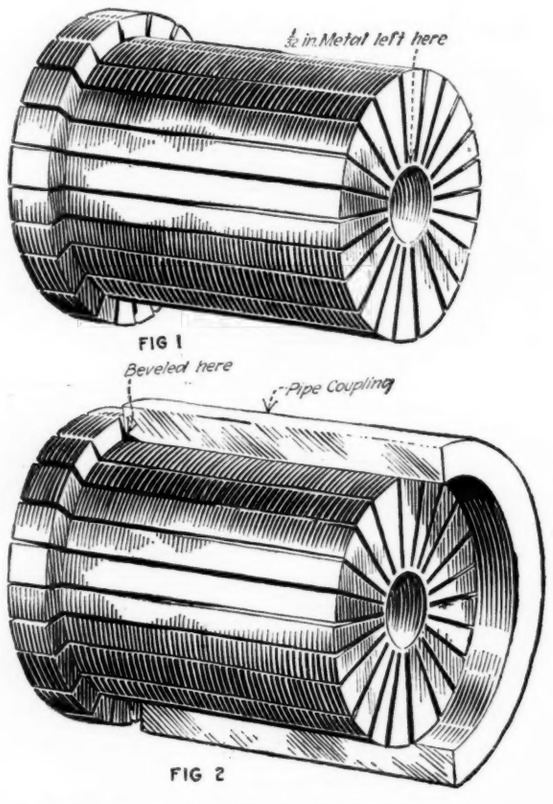
Commutator Made from Copper Block

By Vernon Pearson

Some years ago I had occasion to replace the commutator of a small generator; the job was done in what I believe to be an unusual way, and I pass it along for what it is worth.

The dimensions of the commutator to be replaced were, roughly, 2-in. face by 2¾-in. diameter. A block of copper was secured about this size and a 1¼-in. hole drilled through its center and placed in a lathe on a mandrel. The back gears were used for a dividing head, and the number of slots were laid off across the face ends. Then, after taking the blank off the mandrel, the slots were sawed down to within 3/32 in. of the bore, as shown in Fig. 1.

These slots were next filled with sheet mica coated with shellac. A 2¼-in. pipe coupling was placed in the lathe chuck and bored out to within about 1/64 in. of the outside diameter of the blank, with the outer end of the bore beveled off to make entrance easy. After trimming the excess mica, the blank was forced into the coupling, Fig. 2, by placing the two between the jaws of a vise and closing them. The piece was then mounted



FIGS. 1 AND 2. SHOWING CONSTRUCTION OF THE COMMUTATOR

in the lathe chuck and the center hole bored out to its proper size, thus removing the 3/32-in. of metal left to hold the blank together. A careful inspection was made of the bore to see that no pieces of chips remained to bridge any slots, and then the piece was mounted on a mandrel and the ends shaped to receive the clamping rings.

After mounting the new commutator on the armature shaft, the pipe coupling was pulled off and the face turned down to a fine finish.

Lining Up a Motor for Shafting or Machine Drive

By K. A. REED

How to install a motor on the ceiling, wall or floor and line it up to shafting is explained and methods of handling the motor during installation are given.

FOR the inexperienced it is generally somewhat of a job to properly install a motor so that its pulley will line up correctly with the pulley on the lineshaft to which it is to be belted or to the individual machine which it is to drive and in such manner that satisfactory operation will be obtained. Upon giving the problem serious thought, however, it will be found that by bearing in mind a few fundamental principles and applying them to each individual case, the solution is usually fairly simple.

In the first place, as every engineer knows, the shaft of the motor must be exactly parallel to the lineshafting or the shaft of the machine which the former is to drive. Secondly, the center of the pulley of the motor must be in line with the center of the pulley on the lineshaft to which it is to be belted, and such details as leaving room for tightening the belt (that is, do not mount the motor too close to a column or beam, which would prevent it from sliding on its base), having the motor as accessible as possible for cleaning, with the oil wells easy to get at, choosing just the right place for the starter, etc., must not be overlooked. In selecting the location for the motor, the question of proper distance between shaft centers for the ratio of the pulley diameters should be taken into consideration. If the motor is to be suspended from the ceiling or mounted on the wall, care must be used to see that a foundation of proper design is provided. For floor mounting the foundation should be at least eight inches or a foot above the floor level so that the motor will not be injured by water when washing the floor or dirt from sweeping, and will be accessible for inspection or repairs.

It is usually possible to secure, from the district office of the manufacturer of practically any motor, a dimension leaflet giving complete information about the motor, similar to that shown in Fig. 1. From such a leaflet it is a simple matter to find all the dimensions required for the sliding base or rails, if the foundation is to be concrete or wood, or for the motor feet if it is to be mounted on the frame of a machine arranged for individual drive. In the case of wall or ceiling mounting the foundation details are likewise simplified, and the actual weight of the motor is given. If, however, it is impracticable to secure a dimension leaflet, the principal dimensions can, by using a little care, be accurately obtained by measurement from the motor itself. Such dimensions might be listed as *D*, *E*, *W*, *T*, *J* and *M*, and for the purpose of clearing beams, columns, etc., *H*, *B* and *F*. The essential dimensions can be obtained as follows:

Dimension *D* is taken when the motor is exactly half way between surfaced parts of the slide rails, which act as guides for the motor feet; that is, when the same length of these guides projects beyond each end of the motor feet, Fig. 1. Under these conditions *D* is, therefore, one-half of the distance between the bolt holes in the slide rails in a direction at right angles to the shaft. To get *W* simply measure the diameter of one of the bolt holes in the slide rails. *T* may be secured by placing the end of a rule on the center line of the motor at the eye-bolt, and dropping a plumbline just flush with the oil well in the end bell at the point *x*, Fig. 3. In order to get *J*, place the rotor in the bearings so that one-half of the total end play is on each end of the shaft and measure that portion of the shaft which

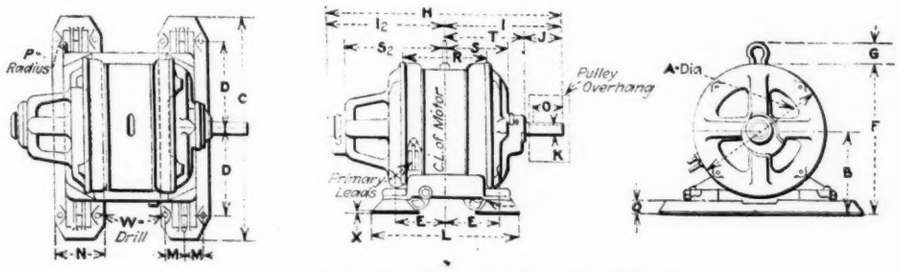


FIG. 1. MOTOR DIMENSIONS DATA SHEET

Frame No.	Fig. No.	Dimensions in Inches Corresponding to Letters in Outline Views														
		A	B*	C	D	E	F	G	H	I	I_2	J	K	L†	M	N
320	4	13 1/2	8 11/32	20	7 3/8	4 1/2	15 5/8	1 1/2	22 13/32	11 1/2	11 13/32	3 1/2	1 1/2	14 3/8	6 1/2	...
330	4	13 1/2	8 11/32	20	7 3/8	4 1/2	15 5/8	1 1/2	24 3/8	11 7/8	12 7/16	3 1/2	1 1/2	14 3/8	6 1/2	...
350	4	13 1/2	8 11/16	20	7 3/8	4 1/2	15 5/8	1 3/4	24 3/8	12 1/16	12 3/8	3 1/2	1 1/2	14 3/8	6 1/2	...
460	5	17 1/2	10 7/16	26	10	5 5/8	19 3/16	1 7/16	32 1/4	17 3/4	14 13/16	5 1/2	1 5/8	16 5/8	2 1/16	5 1/2
540	5	20 1/2	12 3/8	31 1/2	12	6 1/2	22 3/8	1 7/16	35 7/8	19 1/4	16 1/2	6 3/4	1 7/8	18 3/8	2 3/8	6 1/4
550	5	20 1/4	12 3/8	31 1/2	12	7 1/4	22 1/4	1 7/16	37 7/8	20 1/4	17 3/8	6 13/16	1 7/8	20 1/4	2 3/8	6 1/4

Frame No.	Fig. No.	Dimensions in Inches Corresponding to Letters in Outline Views								Key			Approx. Net Wt., Lbs.			
		P	Q†	R	S	S_2	T	W	X†	a	b	c	Bare Motor	Additional for Sliding Base	Additional for Slide Rails	Additional for Pulley
320	4	1	1 1/16	7	5 1/16	9 1/2	7 3/8	5/16	3/8	2 7/16	5/16	1/4	180	20	..	2
330	4	1	1 1/16	8 1/2	6 7/16	10 1/2	8 1/2	5/16	3/8	2 7/16	5/16	1/4	221	20	..	3
350	4	1	1 1/16	8 1/2	6 1/8	10 5/16	8 5/16	5/16	3/8	2 7/16	5/16	1/4	230	20	..	3
460	5	..	1 7/16	9	8 1/2	12 7/16	11 3/8	3/8	1/2	4 13/16	3/8	1/4	375	..	30	4 1/2
540	5	..	1 5/8	10	9 3/32	13 11/16	13 3/16	7/16	1/2	4 3/4	7/16	5/16	525	..	45	11 1/2
550	5	..	1 5/8	12	10 3/32	14 11/16	14 3/16	7/16	1/2	4 3/4	7/16	5/16	630	..	45	11 1/2

* This dimension will never be exceeded. When exact dimension is required liners up to 1/16 inch may be necessary.
† Approximate.
Table correct at date of publication; for latest data apply to nearest district office of the Company.

projects beyond the end bell. By placing a straight-edge across the top of the motor and dropping a plumbline flush with the oil well on one end and another plumbline flush with the end of the shaft, dimension *H*, Fig. 1, is obtained. With the motor resting on the slide rails on the floor, measure the distance from the floor to the center of the shaft and to the top of the motor for dimensions *B* and *F* respectively. Dimension *M* is most readily obtained by turning one of the slide rails upside down and taking half the distance between the holding-down bolt holes in a direction parallel to the motor shaft. Likewise dimension *E* is obtained by turning the motor on its side and taking half of the distance between the bolt holes in the feet in a direction parallel to the shaft. It should be borne in mind at all times that the magnetic center is not always the mechanical center of the motor and this point must be given special attention when connecting a motor to a pump, blower or other machine by means of a flange or other type of solid coupling.

When installing a motor for ceiling operation it is, of course, necessary to turn the end bells, or bearing housings, 180 deg. around the yoke, so that the oil wells will be in the proper position. If the machine is a direct-current motor, it will be necessary to remove the brush-holder yoke and to put the yoke back in place again when the end bell is turned. In making any change in the position of the leads, care should be observed to see that they are replaced in exactly the same electrical and physical position as the original, so that when connections are made in accordance with the diagram accompanying the motor, proper operation will be obtained. For wall mounting the end bells will require shifting only 90 degrees. After the shafting which the motor is to drive has been installed and properly lined up,

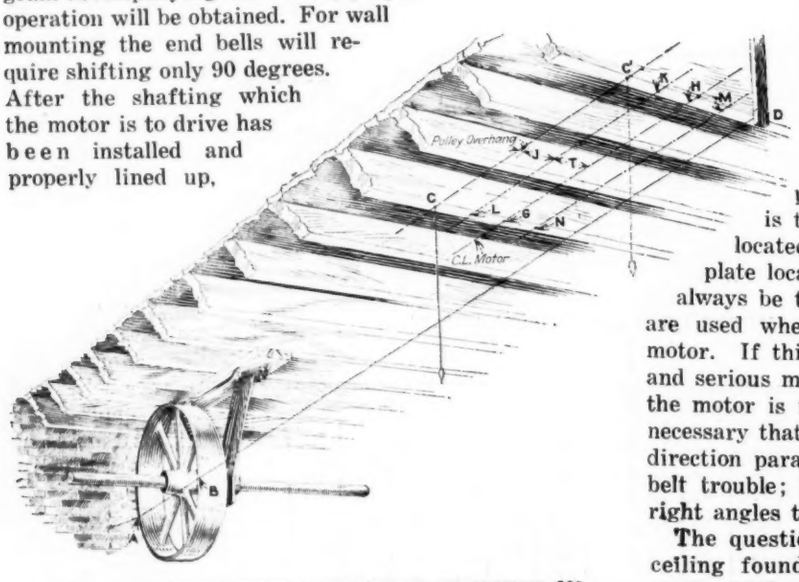


FIG. 2. SHOWS METHOD OF LINING UP MOTOR ON CEILING

fasten a strong cord to a support which has been placed in front and near the center of the pulley on the line-shaft to which the motor is to be belted. Extend the cord across the shaft and somewhat beyond the motor location on the ceiling and move it until it is exactly even with the rim of the pulley at the point *B* on the side opposite to that on which it is fastened at *A*, as per Fig. 2. Draw the cord tight and secure it to the ceiling or to a piece of wood extending down from the ceiling at the point *D*, after which two points *C* and *C'* can be located on the ceiling by means of a plumbbob, as indicated. The line *CC'*, of course, coincides with the outside rim of the driving pulley on the motor shaft. Locate two points *G* and *H*, the distance *J* plus *T*, plus the overhang of the pulley, Fig. 1, from points *C* and *C'*, and the line *GH*, which is parallel to *CC'*, will be the center line of the motor. To obtain the overhang of the pulley place a square or straight-edge across the diameter and measure the distance from the end of the hub to the outside rim. As a rule the location of a standard pulley on a motor shaft is such that the outside end of the hub is not flush with the end of the shaft. After this center line has been located and the distance between shaft centers determined the bolt holes for the sliding base or rails can be readily located from Fig. 1, and are indicated in Fig. 2 by the lines *KL* and *MN*. In building concrete foundations it is usually customary to make a wooden templet either according to dimensions taken from the motor itself or the dimension leaflet. After locating the center line of the motor in the same manner as in the case of ceiling mounting, the templet supporting the holding bolts for the slide rails or base is properly located above this line and carefully leveled. The concrete is then poured in the form which has been provided. When it is necessary to mount the motor on the wall proceed with the line as in the case of ceiling mounting and locate a point *C* at any convenient place on the wall near the ceiling, Fig. 2. With the plumbbob draw the line *CC'*, and this line, as in the former case, coincides with the outside rim of the driving pulley on the motor shaft. Line *GH*, which is the center line of the motor, can now be located and the holding-down bolts for the bedplate located as in the former case. Care should always be taken to see that rigid timbers and bolts are used when building a wooden foundation for a motor. If this is not done vibration is sure to follow and serious motor trouble may be the result. Whether the motor is mounted on a ceiling, wall or floor, it is necessary that the slide rails or bedplate be level in the direction parallel to the motor shaft in order to avoid belt trouble; leveling the bedplate in the direction at right angles to the motor shaft is also advisable.

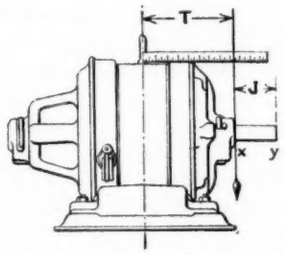


FIG. 3. OBTAINING MOTOR DIMENSIONS

The question of actually placing the motor on its ceiling foundation often proves troublesome if the motor is too heavy for four or five men to handle while standing on a platform. Under these circumstances a scaffold strong enough to support the motor and men safely should be built under the foundation and as close to the bottom of the foundation as possible and still permit the motor to be raised by a block and tackle and landed on it, as shown in Fig. 4. A safe and easy way to handle the motor when it is upside down and prevent it from turning is to support it on a wooden frame made out of 2 x 10-in. planks the top sides of which are curved to fit the frame of the motor, as shown on top of the scaffold. This frame should be placed on pipe rollers so that the motor can be easily moved under its proper position.

When this has been done each end of the frame in which the motor rests can be raised alternately a few inches at a time and blocking inserted until the motor reaches its operating location. Placing the motor on its foundation on the wall is a much simpler operation, since it is only necessary to suspend a chain

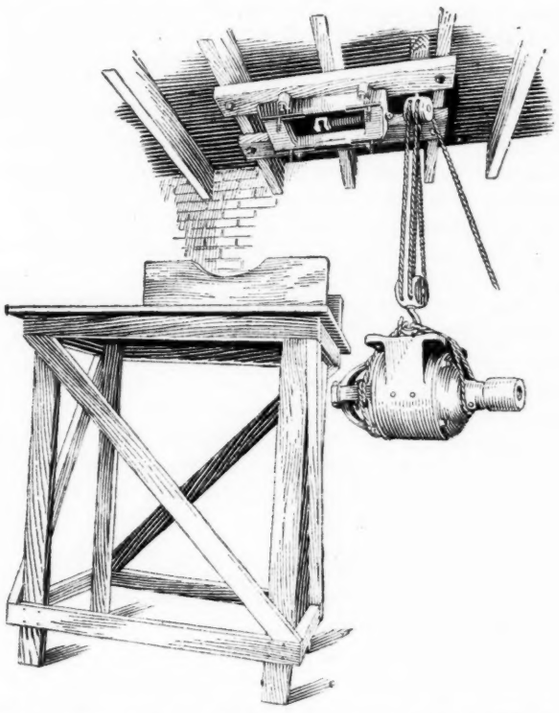


FIG. 4. METHOD OF HANDLING MOTOR WHEN INSTALLING IT ON CEILING

block or block and tackle from the ceiling immediately over the foundation near the wall and lift the motor directly onto the holding bolts.

Royer Flow Indicators

In the June 17, 1919, issue the Royer Flow Meter was described. Since that time the manufacturers, the A. H. Sloan Co., Inc., of Detroit, have made refinements in the design and developed a number of types for specific uses. All the meters are based on the Pitot-tube principle and are purely indicating instruments.

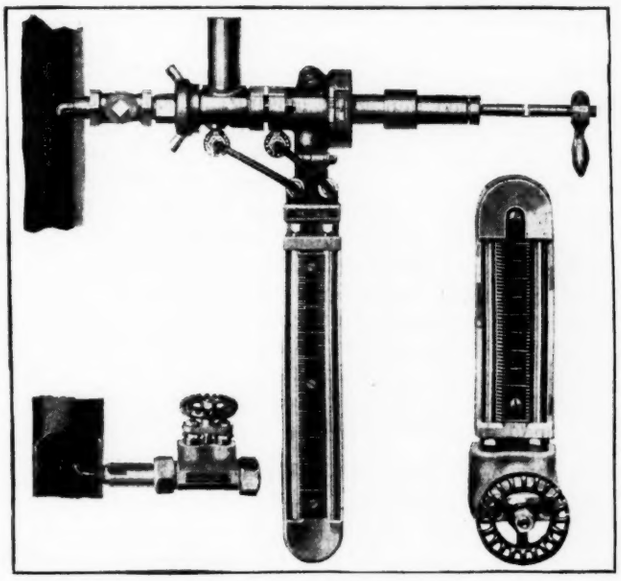
In the accompanying illustration the upper view shows a light, compact meter for portable use. A shut-off valve is attached to the pipe, and the instrument is inserted into the valve and secured by means of the wing nut, after which the valve is opened for the entrance of the impact tube. The main body, or barrel, of the instrument is separated into two chambers. The impact chamber consists of a bored opening in the outer half of the body of sufficient length to permit a range of movement for the impact tube when making a search or traverse for the mean velocity point in all sizes of pipe. This chamber is connected to one leg of the U-tube by means of a valve and flexible high-pressure tubing. The static chamber leads from the end of the connection inserted into the wall of the pipe terminating at the valve and has flexible connection to the other leg of the manometer. The two chambers are separated by a simple type of stuffing box, the gland of which is the outer half of the main body of the instrument carrying the impact chamber.

The manometer is so mounted that it is adjustable for various slope angles, the position being controlled by the leveling collar mounted thereon. This feature enables the operator to measure low velocities such as are encountered in the metering of air and gases. It may also be removed from the plug end of the instrument and mounted on a separate base, where there is sufficient vibration in the pipe line to interfere with accurate reading or where it is necessary to apply the plug in a position that would be inaccessible for obtaining a reading.

The two lower views show the instrument designed for measurement of chemicals such as bicarbonate of soda solutions, saponified oils, cutting compounds, ammonia liquors and other corrosive mediums. The nozzle plug is shown at the left and the manometer at the right. An oil seal is sometimes provided to prevent the solution being measured from coming in actual contact with the steel parts, and those parts which it is impossible to protect are made from monel metal or other alloys, depending upon the chemical action encountered.

This type of meter is especially adapted for conditions where the point of measurement is isolated from the place at which the actual reading is to be taken, that is, the indicating unit, or manometer, is separated from the other member of the meter, commonly called the nozzle plug, which carries the impact and static chambers which are connected to the two legs of the U-tube in the manometer unit.

In applications involving the measurement of liquors or solutions carrying solids such a tar, the instruments



THE ROYER FLOW INDICATOR

The upper view shows an indicator for portable use, and the two lower views show a type designated for measuring corrosive mediums.

are furnished with a steam connection for clearing the impact tube. The same instrument is also adaptable for measuring fluids under extremely high pressures.

The average increase in freight rates on commercial bituminous coal under the new rates which will go into effect shortly by permission of the Interstate Commerce Commission will be about 57 cents per ton according to an estimate of a railroad statistician of high standing, given to the *Coal Review*.

Reminiscences of An Engineer

By W. D. Forbes

In a former article I referred to the Baxter engine, which, it seems to me, anticipated the fundamental idea of the locomobile engine. In the locomobile engine the heat of the boiler and smokestack is utilized to keep the cylinders hot. This conforms with the dynamic law which would make for economy in any design of steam-driven machine.

Mr. Baxter, I believe, was the man who designed the system of propulsion for the Erie Canal. In his system the propeller was only partly submerged, and I think it was reported as the most satisfactory system presented. A prize was offered in the early seventies, I believe, by the State of New York for the best method of canal towing, but I do not think anyone received the prize. Now we have from France records of experiments driving canal boats with a propeller entirely in the air, and it appears from them that the system is practical, but I think that the published reports of the trials give results that can be fairly questioned. The speeds obtained seem far too high for the power expended. Mr. Baxter started on the right road by lifting his propeller, but did not go quite far enough.

I do not have the records handy of the results of my Baxter-engine tests, but I am quite sure that they showed a water consumption of less than half of that of the usual small steam engine. The only reason why this engine was not widely used, it seems to me, was that the low cost of fuel resulted in buyers of small prime movers giving little or no thought to economy, first cost governing.

People bought the Baxter engine mainly because it was self-contained and good looking. About the time I tested the engine, I went to the graduating exercises of a class at Stevens, when Professor James Denton, one of the graduates, read his thesis on "Locomotive Traction." Horatio Allen delivered the address to the class. I went to President Morton's house after the exercises and met Mr. Allen, and in a conversation with several engineers there he remarked that he often thought that it would be possible to send the exhaust of a locomotive around the cylinders and steam chests and thus effect a great saving in steam, and he believed that too little attention had been given to keeping the cylinders of locomotives hot.

The Engines of the "Battery," Stevens' Steamer

The conversation then turned to marine steam engines, and it came out that the first engines designed for the celebrated Stevens' steamer, the "Battery," were multi-cylinder affairs, eight cylinders in each engine, driving the propellers direct. Twin screws were fitted in the design, but the engines were never built, although the patterns had been made. At that time the "Battery" was partly finished, and in walking down Hudson Street, Hoboken, on the east side you walked over the bow of the "Battery." The boat was constructed in a hole, dug to receive it, as it was believed by marine men that it would not be possible to launch such a heavy vessel in the usual way, so the hole was dug and a bulkhead left between it and the river. This was to be dredged away, allowing the water to fill the hole and float the vessel.

John Stevens' first propeller boat was built in 1804. It had twin screws coupled up with gears, and the boiler was a coil or coils of pipe. This is in general the design that we are putting into ships today.

Just above President Morton's house was Castle Point, the home of the Stevens family for many years, and the house was the first dwelling ever heated by steam. The work was laid out and done by Francis Stevens, a cousin of the late Col. E. A. Stevens, about 1840, I think. Castle Point now belongs to Stevens Institute, and its many rooms have been fitted up by the various classes that have been graduated.

Francis Stevens always claimed to have invented the valve cams used on beam engines, which made the valves move in quick jumps without a jar, and it was fascinating to watch these cams work. Another member of the family laid claim to having invented these cams, but from the talks I had with Francis and others, I made up my mind it was a combination invention. One of the Stevens got the idea of having cams lifting the valves, but, as first made, the contact was a blow in fact and gave trouble; and then Francis improved on the idea by the rocking cam, or, as he often called it, the "alligator jaw," which made the cam action smooth and quick just where quickness was wanted. Of course I may be wrong in this assumption, but I know that Francis had in his possession the original drawings of the cams.

Compound Engines for Railroad Tugboats

Francis Stevens was the engineer of the Hoboken yards of the Pennsylvania Railroad floating equipment, and he designed the first compound engines used on the tugs of that company. These engines were steeple compounds, and the first I ever saw where the low-pressure cylinder was set above the high and the stuffing boxes were interior ones; that is, they could not be reached without taking out the low-pressure pistons.

The reason for this design was to keep the engines as low as possible for if the usual exterior stuffing boxes had been used the height of the engine would have been materially increased. The interior stuffing boxes never gave any great trouble. Remarking on this to one of the towboat engineers, he said: "If those stuffing glands leaked, how could I find it out unless I got cards taken?" Of course, to a certain extent, that was true. The packing used in the stuffing boxes was metallic, and Mr. Stevens told me that its design was obtained from the Cold Spring works, just across the Hudson River from West Point. Mr. Stevens remarked that his experience went to show that the metal of the packing had more to do with its satisfactory working than did its design. I do not wish to give the impression that Mr. Stevens was the first designer of a compound engine in America, as that honor belongs without doubt to Charles Hyde, of Bath, Maine.

The Willans Compound Engine

Speaking of steeple compounds, there was one of this class that sold in England to an extent, I was told, that was equal to all other styles of engines put together. It was known as the Willans. It was single-acting and most often seen in multi-cylinder design. It was almost silent in action, and being entirely inclosed, it required very little care, and its economy was satisfactory. I think the Bullock Co., of Chicago, undertook to make the engine in this country, but I never ran across one here.

Economy is a word just now in the mouths of all people and is not confined to engineers. A reduction in manufacturing is equal to an advance in price, so everyone is hard after economy of production, but at times economy is disregarded for reasons which offset any apparent saving.

The Direct-Acting Steam Pump

The most striking example of this, in engineering, to my mind, is the direct-acting steam pump. The cost of pumping with this design is known to all engineers, but the design is so simple, compact and cheap, and the pumps are so easily obtained, that the economy is willingly disregarded. I suppose more pumps of this style are in use than all other designs put together several times over. All one has to do is to explain the requirement and get just what is wanted, almost by return mail, and it will fill the bill. The pump is self-contained and can be piped up by anybody, and a very short time after its arrival it can be put to work. All this is fine and practical, but when it comes to paying for the steam to run and then seeing the work done, one is sad, that is, the one who is doing the paying. I do not believe that the design could be driven out of the market if the steam consumption was four times as great as it is or if prices were increased in the same proportion.

When Alexander Hamilton conceived the idea of making Paterson, N. J., the great manufacturing center of the country, he did so because the water power of the Passaic River was, he considered, quite enough to do the work for all America. At that time water was the only power known to him or to the world. How short was his vision! Yet it was far greater than other men of his time. Within two miles of the Falls the Rogers people turned out locomotives by the score in less than 75 years from the death of that great man, eclipsing the power of the falls many times. The river for power, the river for transportation, was Hamilton's idea, and for his time it was a correct one.

The Corliss Rotary Engine

I was once taken, by George H. Corliss, to a place just outside of Providence, R. I., to look at a foundation for a pumping engine which he had built, I think. Mr. Corliss was a man with whom I got on very well at times, and he seemed to be impressed with my ability to "chase x's" and several times got me to work out mathematical problems for him seemingly with the intention of merely noting the difference between my way of working and his.

On this trip Mr. Corliss opened a vague conversation on a steam prime mover, at last saying that he had an idea of a single-piece engine; that is, where only one part would move, except the governor.

"What!" I exclaimed. "A rotary engine?"

This annoyed Mr. Corliss and he at once changed the subject, but returned to it later in the day, suggesting that I undertake to build the apparatus, but he as designer or originator of the idea need not be known. I did not like undertaking the work under any such understanding, so for some years the rotary engine was never referred to between us. At last Mr. Corliss asked me to make some drawings showing the principle of the engine so that he could have a patent search made. Now that Mr. Corliss is dead, I do not feel that I am acting unfairly to his memory in giving an outline of his idea.

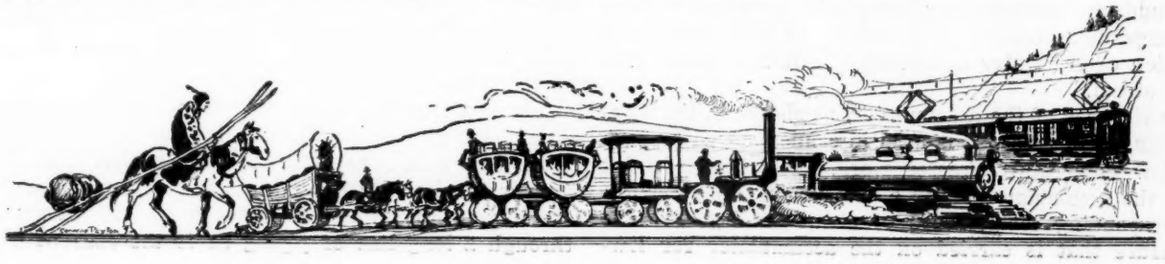
The engine consisted of a cast-iron case which was cone-shaped, a rotor fitted the bored taper hole of the casting, and on this rotor were to be milled steam pathways the bottoms of which were parallel to the center of rotation. The faces of these steam pathways were to be curved, a tangent leading, however, to the curved face, the curves increasing, slowly at first, then steepening rapidly to a short tangent at the larger end. The special form of curve was only on the power side of the pathway. The steam entered at the smaller end of the cone from several nozzles, and as it traveled along the pathway was, of course, meeting with an increasing surface, owing to the cone shape.

A first cone was separated from a second by heads pierced with holes, thus making a steam chamber, and from this chamber the steam was again led into nozzles in the second head to a second cone, larger, of course, than the first. Several cones were to be used, making stages, and it was proposed to use a condenser. After the drawings were begun, Mr. Corliss changed them by adding check valves to the exhaust holes, and he proposed to use a little live steam in each chamber.

One side of the steam pathway was to be formed with great care, and Mr. Corliss cut three forms out of paper. One was the form at the end of the first tangent, one at the middle, and one at the end of the pathway that led to the final tangent. How he arrived at these forms I was never told, but I was to make the complete spiral pathway lead smoothly to these cross-sections.

If I remember rightly, Mr. Astor patented a steam turbine in which spiral fins were placed around a drum and steam entered a casing at one end. The rotor was quite long and parallel, but in this design there was no cone, steam receiver or stages. I never knew whether Mr. Corliss finished an actual engine. I became tired of working in the dark. I wanted his entire confidence, and as I was not able to get it, I decided to drop the matter.

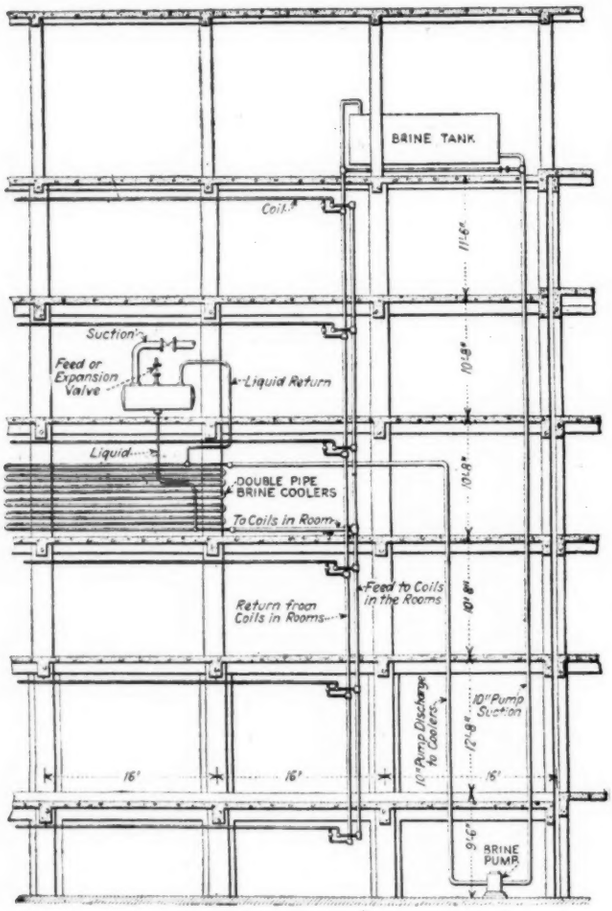
The drawings were labeled, "Proposed Experimental Centrifugal Pump," or some such designation. One day very much later I took up the subject while driving with Mr. Corliss, and he said: "That pump idea I want to modify, by turning annular spaces in the cone rotor and fitting in these spaces especially shaped fillers fastened to the case so that they will act as steam abutments." As I look back on these ideas of Mr. Corliss, it strikes me he came pretty near inventing a steam turbine as early as the year 1884.



Handling the Flooded-Type Brine Cooler

By B. E. HILL

SOMETIMES with the flooded-type brine cooler as applied in connection with the double-pipe brine cooler, the accumulator is used. The duties of the accumulator, when used for this purpose, are similar to those of a blowoff tank connected to the blowoff lines from steam boilers. A blowoff tank is used to prevent blowing high-velocity steam and water into the city or private sewer lines and thereby prevent damage to them. As the blowoff tank is vented to the roof (atmosphere) with a line large enough to cut down the high velocity, this allows the water to flow off into the sewer while the steam is carried off through the vent.



PIPING LAYOUT IN A WAREHOUSE

A boiler carrying 150 lb. pressure has a boiling point around 365 deg. F. When water from such a boiler is suddenly released to atmospheric pressure with a corresponding boiling temperature of 212 deg. F., a portion of the water is instantly flashed or evaporated into steam.

In the case of the accumulator, as shown in the illustration, assume that it is used in connection with sharp or low-temperature freezer work. The liquid is fed into the accumulator under a pressure of 180 lb. and a corresponding temperature of about 95 deg. F. The pressure that is carried on the accumulator for low-temperature work we will assume to be zero, or atmospheric pressure. As the boiling point at atmospheric pressure is about 28½ deg. F. below zero, a portion of the liquid ammonia is instantly flashed or evaporated into a vapor for the same reason that the high-temperature water is evaporated as it leaves the blowoff tank and goes into the atmosphere.

The object of the accumulator is to remove the vapor or saturated ammonia gas from the liquid ammonia and feed the liquid ammonia to the brine cooler at the reduced temperature due to the reduced pressure, allowing the gas evaporated in this way to pass off into the suction line and on to the compressor the same as the steam from the vent in the blowoff tank passes out to the atmosphere.

The merits of the accumulator, when used for this purpose, over the direct feed into the bottom coils lie in the fact that it affords a space large enough to separate the gas from the liquid and pass the gas on its way back to the compressor without first passing it through the entire length of the brine-cooler coils.

Another advantage of the accumulator is the safety feature. In case a sudden change in temperature of the brine through the brine cooler causes a rapid evaporation of ammonia and throws the liquid out of the coils into the accumulator, which would gravitate back to the cooler instead of to the compressor, as would be the case where there is no accumulator, the latter would act the same as a separator on a steam line and the coils act like a priming boiler that is short on steam space.

The illustration shows a system of calcium brine coolers with the pumps in the basement or cellar floor and a makeup brine tank on the seventh floor, an explanation of which is hardly necessary.

The Shell Brine Cooler

The shell brine cooler is nearly like a surface steam condenser and also embodies the principles of the return-tubular boiler.

For simplicity, capacity, efficiency, compactness, durability and no leaks, the well-designed and well-built shell brine cooler is among those at the top of the list. There have been mistakes made in these coolers as well as in all other apparatus. The writer will try to point out some of the most serious as a guide to the engineer operating these coolers or who is expected to draw up specifications for their purchase.

The best design of shell for durability and strength has the longitudinal seams riveted together with a double butt-strap seam with the calking edges welded inside and out. The heads are flanged out beyond the shell, which allows for expansion and contraction without serious strain on the tube sheet caused by a short bend. The tubes for these coolers can be made either of charcoal iron or steel, rolled and beaded the same as the tubes in a return-tubular boiler.

The capacity as well as efficiency of these coolers is due to the circulation, there being no dead corners as is the case with the submerged brine cooler. The large area or surface for the saturated gas to pass out into the suction line as soon as evaporated, without passing through a long line of piping as is the case with the

double-pipe and other types of pipe brine coolers, makes it possible to carry the brine temperature closer to the temperature of the boiling ammonia without generating an internal pressure caused by the violent boiling of ammonia. The closer the engineer can run the boiling point of the ammonia in the brine cooler to the temperature of the brine, the greater will be its capacity and efficiency; in other words, carry the suction pressure as high as the required temperatures will permit, which will give the maximum capacity, and install a brine cooler that will deliver brine as close to the boiling point of the ammonia as possible and practical.

The greatest objection to the installation of a plant to obtain the capacity and efficiency as mentioned, is the cost of the evaporating coils or brine coolers of sufficient pipe and tube surface and design to obtain results.

Rapid Circulation of Brine

As before stated, one of the greatest features of the shell brine cooler is the rapid circulation of brine. One of the mistakes that has been made in the past is in carrying this valuable feature too far, the brine being made to pass back and forth through the tubes so many times that the combined area of the tubes in each pass was reduced to such an extent that the friction head was abnormal, there being a difference in pressure between the inlet and outlet of from 15 to 90 lb., depending on the quantity of brine required to be pumped through the cooler.

These coolers are limited in the diameter of the shell to about 48 or 54 in., and the number of passes in many instances have been made from eight to twelve, with bad results as to friction head. It is the judgment of the writer that in no case should the number of passes exceed six, and in no case should a brine cooler be purchased without complete specifications, stating the range in temperature, maximum quantity of brine to be passed through the cooler in a stated time, allowable friction head between the inlet and outlet, etc., which will put it up to the manufacturer to design the cooler to meet requirements.

Manufacturers' Guarantee

Owing to the danger of "freeze-ups" in these coolers, the manufacturer in most, if not all cases, will not guarantee them for anything but a solution of calcium chloride of sufficient strength to prevent freezing. The late P. J. Slagle, chief engineer for Swift & Co. for many years, "thrashed" this point out with several of the leading manufacturers and has successfully operated the shell brine cooler for years in many of the Swift plants with a solution of common salt brine. The circulation in these coolers is so nearly perfect in all parts of the cooler that it is only necessary that the circulation be kept up, and to do this the engineer must have some assurance that the pump is kept going at all times while the machines are in operation. Mr. Slagle, being thoroughly familiar with this part of the operation, installed a check valve on the outlet end of the brine line with the stem extending through a stuffing box. Attached to the valve stem is a lever which answers the double purpose of a counterweight, which closes the check valve when the flow stops, and makes contact with an electric switch. This lever is so adjusted as to ring a bell and light a red signal light when the pump stops or shows to the danger point, as the valve will vary the distance of opening according to the flow of brine.

These coolers can be arranged for installation either horizontally or vertically. The horizontal installation requires more floor space and less headroom, but is much easier to repair when necessary. The vertical installation requires less floor space and more headroom and is much more difficult to repair.

These coolers, whether installed vertically or horizontally, should have a trap or good make of steam separator in the suction line between the cooler and compressor, it being installed high enough above to drain back into the cooler in case of overfeeding or priming. Take the same precaution for safeguarding the compressor that you would to safeguard an engine from the boiler, as the cooler is the boiler of the refrigerating plant.

Refrigeration Effect Circulated from Delivery of Brine Pump

To determine the refrigerating effect delivered by the reciprocating brine pump, the first essential is to ascertain with a reasonable degree of accuracy the amount of brine pumped. To do this, close the discharge valve on the pump line and start the pump, regulating the speed at a point where the discharge gage registers normal working pressure; the gage in this case must be tapped below the discharge valve. After the pump has been regulated to hold the required pressure, count the strokes for five or ten minutes and get a good average of the strokes per minute.

Now, for example, assume that the water or brine end of the pump to be used in the test is 10 in. in diameter and 12 in. stroke, and also that the average number of strokes with the discharge closed was found to be 18 per min. Assume brine at 80 deg. salinometer and the specific heat, which in this case would be 9.6 lb. and 0.80 respectively. Then to reduce the 385.4 gal. per min. to pounds, $385.4 \times 9.2 = 3{,}545.68$ lb., and as there was a rise in temperature of 4 deg. between the discharge and return brine and a specific heat of 0.98, the refrigerating effect delivered per 24 hours would be

$$\frac{3{,}545.68 \times 0.94 \times 4}{200} = 66.65 \text{ tons refrigeration.}$$

Oxyacetylene Welding of Damaged Engine Cylinders

Although practically every job undertaken by a welding shop represents a saving of time, labor and money, it is not until some particularly large job comes along that the value of oxyacetylene welding is driven home with a punch. One of these large jobs, the execution of which resulted in substantial saving, was recently completed by the Imperial Welding Co. of Minneapolis, Minn.

The parts to be repaired were the fractured high- and low-pressure cylinders of a 1,000-hp. compound steam engine employed to furnish power for a flour mill. The damage was due to the piston rod fracturing close to the crosshead and the pistons driving through the ends of the cylinders. The fractures in the low-pressure cylinder are shown in Fig. 1. The crack shown in the upper left-hand corner of the picture extended back to and completely around the inlet-valve port. The crack shown at the bottom of this cylinder extended no farther than can be seen in the illustration.

As the casting was preheated the men could not, of course, have worked from the position shown, but they give an idea of the size of the cylinder bore.

The high-pressure cylinder, indicated at the right in Fig. 2, was also badly broken, as the welded section shows. Fig. 3 shows the low-pressure cylinder after it had been welded.

Inasmuch as the engine was of an obsolete type and occupied excessive space in the engine room, upon a report of the accident the owners decided that they would replace it by a steam turbine, but when the matter was taken up with the manufacturers, it was found that no delivery date could be promised within ten months. This long delay was, of course, out of the question, no outside power being available in the interim.

Then an effort was made to obtain the old patterns from the firm that had originally made the cylinder. Here again the owners met with disappointment. The original patterns had been destroyed, and new castings would have cost approximately $9,000 exclusive of freight charges and cost of installation. The location of the engine room and adjacent machinery was such that the cost of installation would have reached a high figure and would have brought the entire bill, exclusive of the costs of delay, up to approximately $15,000.

Having failed to obtain a steam turbine and not caring to spend such a large amount for new castings, the owners took the matter up with the welding company and upon being assured that the cylinders could be satisfactorily welded the job of reclamation was given to them and men were set to work at once to repair the damage.

Four men were employed in doing the work, the actual time to weld the castings being forty-eight hours. The total amount of time to chip out the castings and otherwise prepare for welding, as well as to actually make the welds, was three weeks. The operation presented no unusual difficulties, preheating being done one section at a time.

The material used for the work consisted of 30 cylinders oxygen, 26 cylinders acetylene, 4 lb. flux, 407 lb. cast-iron rod, 4,150 lb. charcoal and 32 carbon blocks ½ x 6 x 12 inches.

The actual cost of welding these cylinders was $1,572.22. Not taking into consideration the delay that would have resulted if new castings had been made, the owners were able to save over $13,000 by taking advantage of the welding process.

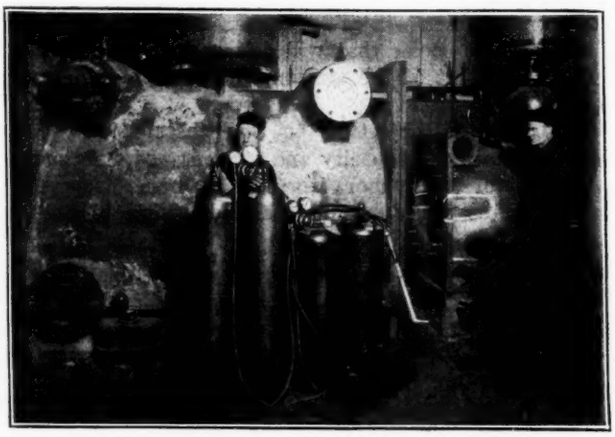


FIG. 2. APPARATUS AND WELDED HIGH-PRESSURE CYLINDER

A month ago the Department of Justice issued special instructions to all district attorneys to bring action against those who are enhancing the price of coal illegally. As a result, indictments have been brought against nearly five hundred bituminous coal dealers throughout the United States. The next thirty days will see even a larger number indicted, it was predicted at the Department of Justice.

FIG. 1. FRACTURE IN LOW-PRESSURE CYLINDER

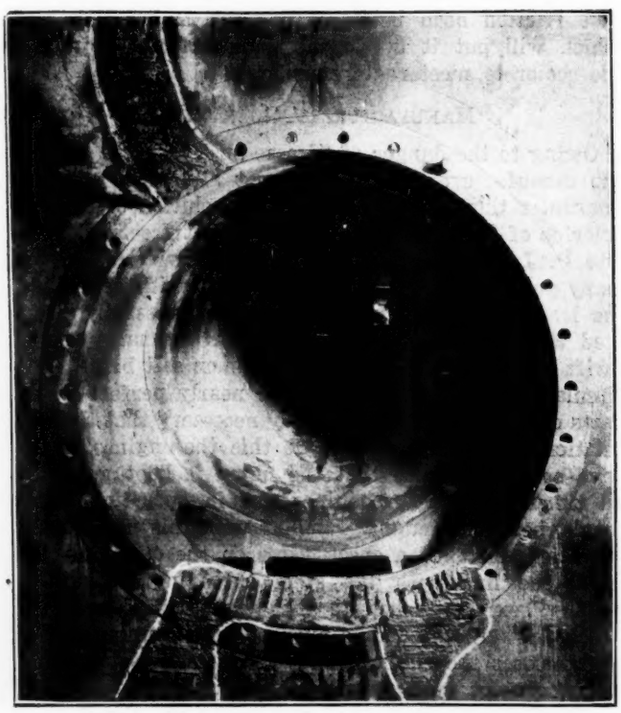


FIG. 3. LOW-PRESSURE CYLINDER AFTER WELDING

Checking Three-Wire Three-Phase Switchboard Wattmeters

By H. C. Yeaton

All switchboard indicating wattmeters should be checked frequently in order to insure their accuracy, and the following covers two methods of checking three-wire three-phase switchboard wattmeters.

In the portable polyphase wattmeter method connect a portable polyphase wattmeter in the circuit, as shown in Fig. 1, 2 or 3. The current terminals of the portable instrument are connected in series with the current terminals of the switchboard meter, and the potential terminals of the former are connected across the potential circuits. The connections, Fig. 1, are those where both current and potential transformers are used, in Fig. 2 current transformers only are used, and in Fig. 3 the instruments are connected directly into the circuit. Switchboard-wattmeter scales are usually marked in primary watts, which are the actual watts or kilowatts of the circuit, and on a balanced circuit at unity power factor are equal to

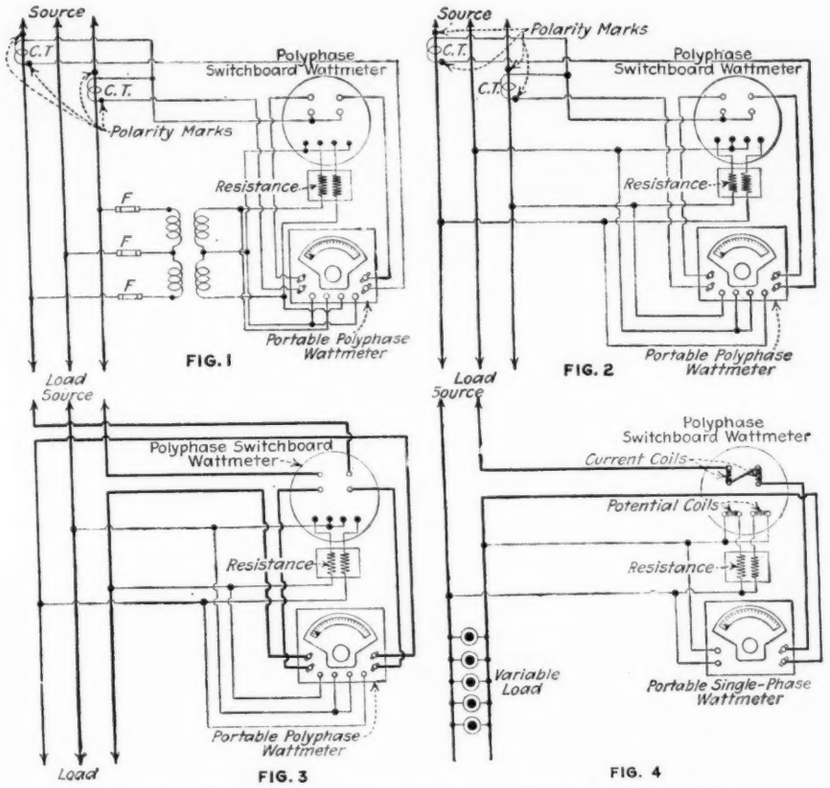
Primary Amperes × *Primary Volts* × 1.732

The calibrating watts of a three-wire three-phase wattmeter are the watts required to make the pointer deflect from zero to full scale, and equal

Scale Range in Watts ÷ *Potential-Transformer Ratio* × *Current-Transformer Ratio*

Then by checking the calibrating watts of the switchboard meter with the portable meter, the accuracy of the former may be determined. For example: Suppose that in Fig. 1 the three-wire three-phase circuit has a rating of 100 amperes and 2,200 volts. Each potential transformer has a ratio of 20:1 or 2,200 to 110 volts; and each current transformer has a ratio of 20: 1 or 100 to 5 amperes. The full-load watts of the circuit at unity power factor would be equal to 2,200 × 100 × 1.732, or 380.6 kw., but as this value would cause the scale to have an uneven ending, a 400-kw. scale would probably be marked on the instrument.

Suppose, now, that the pointer on the switchboard meter indicated 200 kw., then the calibrating watts for this point would be equal to $\frac{200{,}000}{20 \times 20} = 500$. Therefore, if the pointer of the switchboard instrument indicated 200 kw., it would mean that only 500 watts were impressed on it to produce this deflection, and the portable wattmeter, also being connected on the secondaries of the transformers, would indicate 500 watts if the switchboard wattmeter was indicating correctly. [The switchboard wattmeter is calibrated so that it reads directly in primary watts or kilowatts and does not have to be multiplied by the transformer ratios, where portable wattmeters are calibrated to read the watts passing through the instrument and must be multiplied by the transformer ratios to obtain primary watts.—Editor.]



FIGS. 1 TO 4. CONNECTIONS FOR CHECKING WATTMETERS

The foregoing method checks only one point as it probably would not be convenient to vary primary load. Several points may be checked during the day, however, if the load varies on the circuit.

Another method that can be used to check more than one point on a three-wire three-phase wattmeter is to short-circuit the current transformers and disconnect the instrument from the circuit. Then connect the switchboard instrument on a single-phase circuit with a portable single-phase meter, using a variable load, as shown in Fig. 4. In the figure the current coils of the switchboard meter are connected in series, and the potential coils, together with the resistances, are connected across the circuit. The current winding of the portable instrument is connected in series with both current windings of the switchboard wattmeter, and its potential terminals are connected across the circuit. Therefore, as there are two current and two potential elements in the switchboard meter and one current and one potential element in the portable instrument, the total watts impressed on the polyphase meter would be twice those impressed on the single-phase meter, consequently the calibrating watts per element of the switchboard wattmeter equal

Scale Range ÷ *Current Trans. Ratio* × *Potential Trans. Ratio* × 2

Therefore, by determining the calibrating watts of the switchboard wattmeter, from this formula, the scale readings of the instrument may be checked with the single-phase wattmeter.

Suppose that it is required to check the switchboard

wattmeter, as given in previous example, at the readings 100, 200, 300 and 400 kw. First connect the two instruments as shown in Fig. 4. The calibrating watts per element of any reading equal *Scale Reading* ÷ *Potential Trans. Ratio* × *Current Trans. Ratio* × 2. Substituting the readings 100,000, 200,000, 300,000 and 400,000 for the scale reading and dividing by 20 × 20 × 2 (800), the following calibrating table can be made up:

Switchboard Wattmeter Readings in Kilowatts	Calibrating Watts Per Element of Switchboard Wattmeter	Portable Test Wattmeter Readings
100	125	125
200	250	250
300	375	375
400	500	500

Other readings can be checked in the same manner, if it is so desired, but four or five readings are usually sufficient to determine the general accuracy of an indicating switchboard wattmeter.

Coleman's No-Leak Safe Tube End

Following is a description of a method of applying tube ends, the object being to double the life of ordinary tubes, do away with leaking tube ends, to be practically 90 per cent efficient by actual test and to save from 10 to 20 per cent of the fuel bill.

As is well known in locomotive practice, with the old style of tube the Prosser expander forms a semicircular corrugation on the water side of the tube plate. The edge of the semicircle frequently only touches the top of the copper ferrule which is in contact with the plate and does not prevent more or less working of the tube in the plate, which eventually results in leaking tubes, caused by expansion and contraction. The Coleman safe tube end, Fig. 1, which is manufactured by the Coleman Boiler Appliance Co., 406 Grosse Building, Los Angeles, Cal., has a square machined shoulder that fits tightly against the copper gasket which rests solid against the plate. This, with the tapered holes through the plate, 1½ to the foot, forms a wedge where the end is finished and beaded down on the tube plate on the fire side and holds the square shoulder against the plates and prevents movement of the tube in the plate due to either expansion or contraction; hence it prevents leaks. The shoulder carries the vibration.

The merits claimed for the Coleman device lie in the increased thickness of the flue point and in the tapering holes through the flue sheet at the firebox, tapering from the firebox side. When the flue point is set firmly against the plate at the water side and the expansion is taking place, the flue is pushed against the square shoulder on the water side of the sheet and is not pushing the bead away from the sheet on the fire side, as is done by the old method. When the tube is contracting, instead of pulling against the bead and loosening the tube, it is pulling against the tapered hole in the plate and not straining the bead.

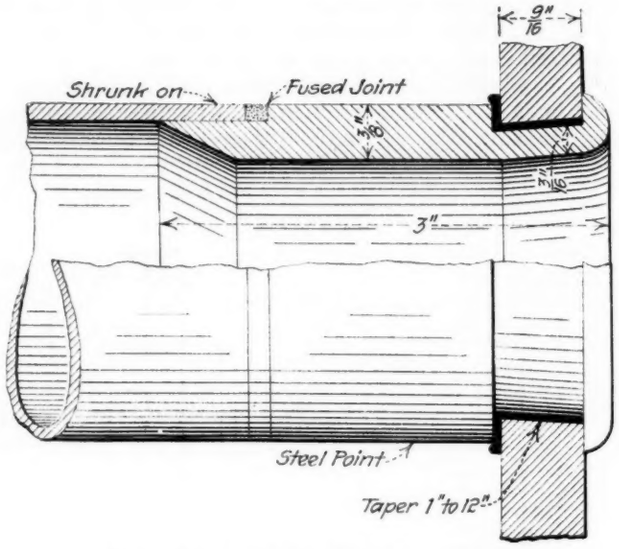


FIG. 5. DETAILS OF COLEMAN TUBE END

FIG. 1. COLEMAN TUBE POINT

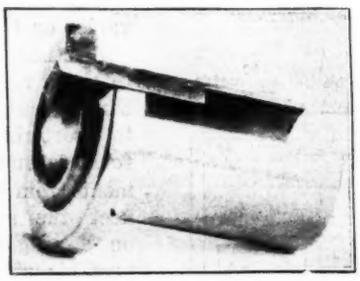


FIG. 2. TUBE POINT WELDED AND EXPANDED

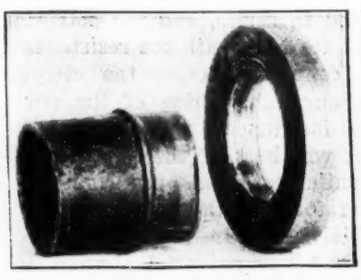


FIG. 3. TUBE PULLED OUT OF THE TUBE SHEET

FIG. 4. TUBE PARTED, BEADING HELD

Figs. 2 and 3 show a tube welded to a tube point and expanded into a ring which represents a tube sheet. A copper ferrule is shown between the tube point and the tube sheet, but Mr. Coleman advocates omitting this ferrule, using a thin one between the shoulder on the point and the inside of the tube sheet. This eliminates one joint in the tube sheet.

In order to properly and conclusively demonstrate the superiority of the Coleman method, both were put under test with the result that a tube with the ordinary expanding and beading pulled out of the tube sheet when under test at a pull of 24,130 lb. and started with a pull of 21,000 lb. This is shown in Fig. 3. Under test the Coleman joint failed to start, but the tube started to break outside of the weld at a pull of 34,000 and parted at a pull of 36,330 pounds, Fig. 4.

The Coleman process has been tested out on one of four engines on the Rio Grande division of the Santa Fe Railroad. These engines were all of the same class and type. Engine 1,117 was equipped with the Coleman safe-tube ends, and the other three engines were fitted with the old-style flue ends, the test being for efficiency, mileage and coal saved. It lasted over fifteen months, when the tubes in No. 1,117 were found as good as when first put in and were declared good for another six months' service. The other engines had each received a second set of tubes four months before.

Operation and Adjustment of Turbine Machinery
VII—Fitting Carbon Ring Packing

By EUSTIS H. THOMPSON
Consulting Engineer, Baltimore, Maryland

VARIOUS numbers of rings are used in packings to suit different conditions. Fig. 1 shows two packing rings used to hold the vacuum end of a turbine. The lower drain is normally closed. Steam is admitted through the upper drain so that the leaking of steam past the inner ring is compensated for and a little extra is supplied, which usually condenses and leaks out of the turbine casing. The steam exerts an axial pressure $P1$ and $P2$ against the carbon rings, as shown. This tends to hold them against the surfaces $D1$ and $D2$. Under ordinary circumstances this joint is practically steamtight. The actual leakage takes place along the shaft. The joints of the rings hold steamtight.

Packing for holding high-pressure steam in the first stage of an impulse turbine—small machine—is shown in Fig. 5. A small amount of steam leaks past the first ring Fig. 1, and this is forced into the drain by the resistance offered by the second ring. This type of packing is generally equipped with three rings instead of

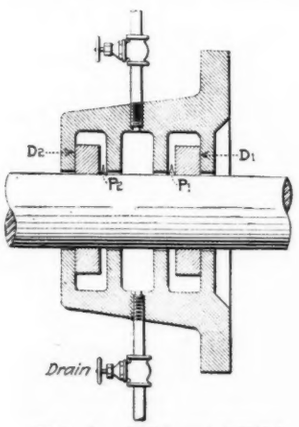


FIG. 1. TWO PACKING RINGS

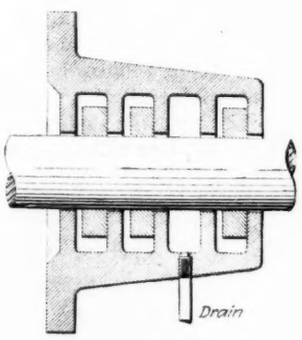


FIG. 2. THREE PACKING RINGS

two, as shown in Fig. 2. It is more difficult for the steam to leak by two rings than one. The leakage going through the drain pipe is much less. Large machines seldom have less than three rings.

Fig. 3 shows the same packing with a drain placed between the first and second rings which carries the leakage from these rings into some part of the turbine where the pressure is lower, so that the leakage may expand and do work. The drain between the second and third rings acts the same as in the two-ring packing.

Fig. 4 shows a high-pressure packing adapted to a condensing turbine. Steam is supplied for the purpose of sealing against the vacuum. When the turbine is loaded and a steam pressure exists between the first and second rings, the sealing steam is not necessary. Often the sealing steam is supplied through a reducing valve and the steam line is equipped with a check valve. Another combination of four rings to accomplish the same purpose is shown in Fig. 5. Sealing steam is here admitted between the third and second rings. It can be left turned on whether the turbine is loaded or unloaded. The drain is placed between the first and second rings and leads to one of the lower-pressure

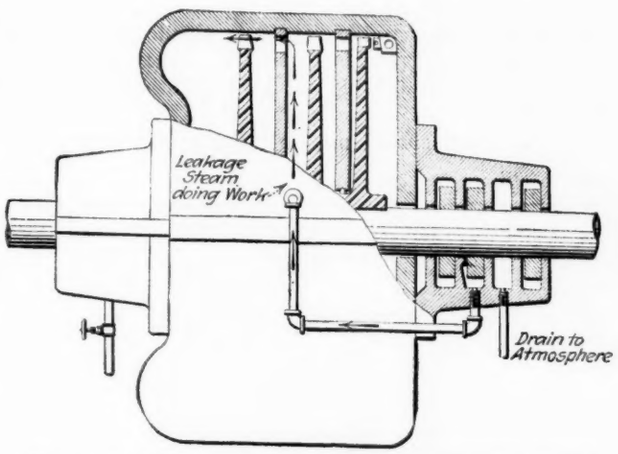


FIG. 3. SHOWING PIPING OF DRAIN BETWEEN FIRST AND SECOND RINGS

stages of the machine. The drain between the third and fourth rings opens to the atmosphere.

Various combinations of rings and drains are used to suit the conditions of the machine. In any case the action will be the same as far as leakage is concerned,

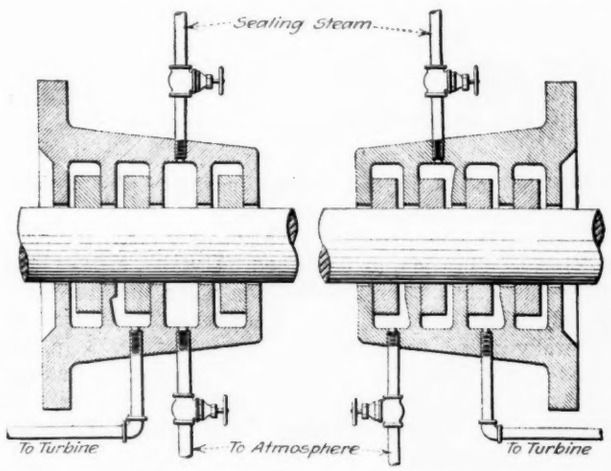


FIG. 4. HIGH-PRESSURE PACKING

FIG. 5. COMBINATION OF FOUR RINGS

whether the rings are carbon or metallic. The latter material is used principally on small machines.

In impulse turbines it is often the practice to place interstage rings between two stages to prevent steam leaking from the higher to the lower stage. These rings are generally single and seldom more than double. Carbon or the labyrinth metallic ring is generally used.

Old rings can be refitted for a fraction of the cost of new rings, more especially in larger machines. When new rings are installed, the engineer should thoroughly understand their nature to be sure that the factory has supplied them with the proper dimensions, machine work and clearances. The principles of adjustment are as follows:

1. The ring should not be smaller than the diameter of the shaft.
2. This should not exceed the diameter of the shaft more than a certain fixed amount.
3. The rings should be free to move in their grooves so that they can change their position when expansion or contraction of the turbine casing changes its relative position with the shaft.
4. Joints between the segments should be true flat surfaces bearing throughout their whole extent.
5. These joints should be held together firmly by the springs.
6. The rings should not be too free in the casings.

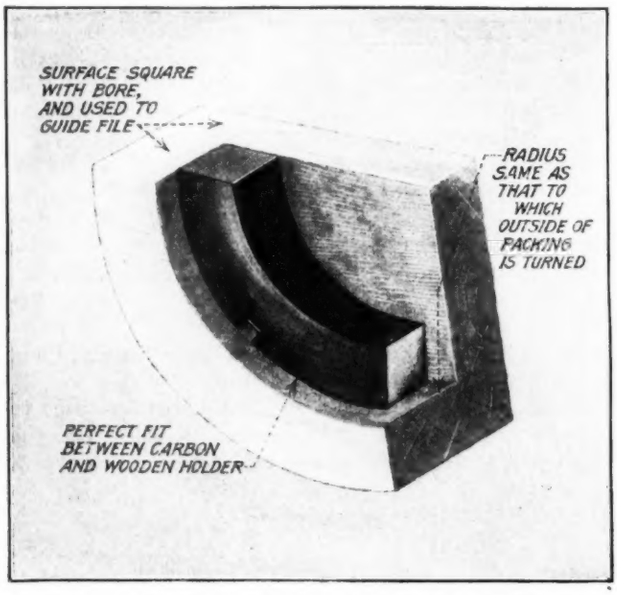

SURFACE SQUARE WITH BORE, AND USED TO GUIDE FILE
RADIUS SAME AS THAT TO WHICH OUTSIDE OF PACKING IS TURNED
PERFECT FIT BETWEEN CARBON AND WOODEN HOLDER

FIG. 6. MODEL FOR HOLDING OLD RINGS

7. The joints in the various parts of the casings should be made steam-tight.

When the ring is smaller than the shaft, it causes cutting or vibration, as described. Usually, a day's run will wear it into running condition when the difference is only 0.004 to 0.006 in. in diameter. The rings are generally fitted to exceed the shaft by 0.002 in. or 0.003 in. per inch of shaft diameter, which is an allowance for ordinary shaft expansion together with a net clearance of approximately 0.0005 in. to 0.001 in. per inch of diameter. For high pressures and superheat allow 0.003 in. per 1 in. diameter

In refitting old rings a good way is to have a wooden model made of the size of the packing which is split in an axial plane, as shown in Fig. 6. The joints can be dressed down to a true surface with a file so that the ring will come together to a considerably smaller diameter than the shaft; each joint should be marked with a number so that it can be taken apart and correctly put together. This complete ring should be put in a lathe and centered as nearly as possible with its outside surface. The inside can then be bored to the proper diameter. If it is rebored too large, the joint surfaces can be dressed with a file.

The bored surface of the rings can be made smooth by polishing with No. 00 sand paper. Emery cloth should never be used on the packing as the particles of emery may stick to the packing and badly cut the shaft.

Another way of making the ring diameter smaller before boring it in the lathe is to place the ring

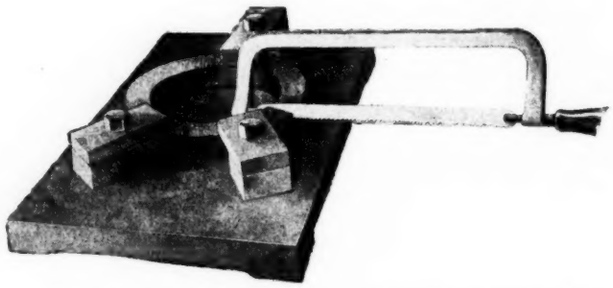


FIG. 7. METHOD EMPLOYED IN MAKING RING OF SMALLER DIAMETER

assembled on a board and clamp it as shown in Fig. 7. Be sure that the joints are in good contact. Then take a hacksaw and cut through each joint, keeping the saw in a radial position so that the blade lines up with the center of the ring. The segments can then be removed, and the thickness of material which was thus cut off from each joint should allow the ring to come close enough together for purposes of refitting.

When rings are but slightly worn so that 0.003 to 0.006 in. must be taken from the diameter, it is not necessary to rebore, but only to file the joint surfaces as before described. If desirable to fit these without a wooden form, the easiest method of keeping the surfaces true is to place all the segments together in a vise (see

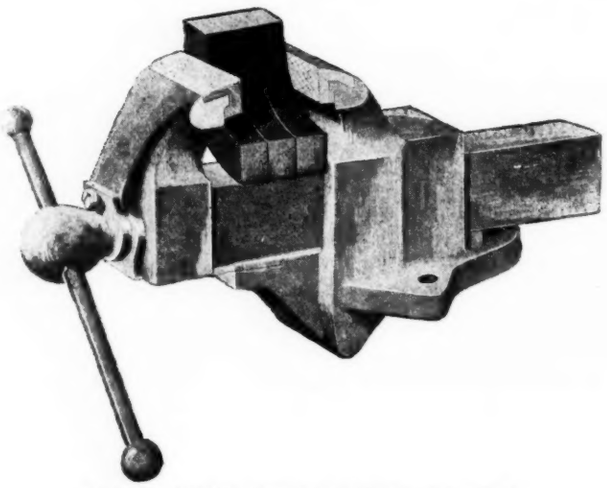


FIG. 8. RINGS BEING FITTED IN VISE

Fig. 8). Line up the joint surfaces at each end so they are in a plane before tightening thoroughly in the vise. Remember that carbon is brittle and will not stand much pressure. If the vise jaw is rough, line it with sandpaper. All the joint surfaces on one end can now be filed together. This makes it much easier to handle the file to produce a practically true surface. If the segments are filed one at a time, it is difficult to make the joints bear on the entire surface.

EDITORIALS

The Status of the Oil-Engine Operator

THE manufacturer has excellent grounds for his claim that the oil engine has emerged from the development stage. Only a radical partisan of the steam engine will refuse to agree that the oil engine has arrived. This prime mover has been sold to the engineering public; the efforts of all concerned in the industry should be directed toward seeing that it stays sold.

The present-day problem is not one of design, but is essentially one of operation. There is one condition existing in numerous oil-engine stations which, if not corrected, will eventually result in a recession of the popularity of this prime mover. This is the degree of engineering intelligence and skill possessed by the engine operator. Only in a few instances are the operators as well trained as are the engineers in steam plants of equal capacity. It seems quite the custom to employ some man who has had a few months' experience in an automobile shop. This man, who knows nothing of engine maintenance or even of the theory of the engine's operation, is placed in charge of a machine costing thousands of dollars. Even men who have operated oil engines for a considerable time appear to understand only in a vague way the principles of the engine's cycle, the necessity of keeping the various parts in adjustment and the amount of clearances allowable in the several moving parts.

The engine manufacturer realizes the high-grade workmanship required in the construction of the engine and so employs only the highest type of machinists. The power-plant management should be impressed with the thought that only high-grade mechanics are capable of successfully operating the engine. The engineer should realize that the machine under his care represents the highest development of prime mover—that the slightest departure from proper operating procedure will eventually result in a failure—that adjustments are matters of but a few thousandths of an inch. There is no room for the yardstick or the wooden rule in the Diesel-engine plant.

In practically all instances of oil-engine failure, the underlying cause has been the lack of care the engine received from the operating force. Largely, the fault is not one of slothfulness, but comes from lack of information at the command of the engineer.

It follows that both the plant management and the oil-engine builder must take steps to remedy these conditions. When making a sale, the manufacturer should insist that the purchaser secure the services of an operator who, however little he knows of oil engines, is a mechanic. In most cases the best type of man can be found in the ranks of the steam engineer. However, care must be exercised to see that the engineer is adaptable.

After the purchaser has engaged his engineer, the latter should be given a course of training at the builder's factory. Here he should be set at work as an erector's helper rather then as an observer. With such training the engineer should be able to show satisfactory results in the power plant. The Diesel engineer must keep in touch with operating practice of other plants. Only by interchange of ideas and experience can the oil-engine operator hope to keep abreast of the times.

In His Working Clothes

NOT long since the editor passed a half day with the chief engineer of a large manufacturing company. He has come up from the ranks, and what education he has he won for himself out of the solid rock. He has no degree of M. E., but he knows that power plant to the last shade of intimacy. He may not have a very clear-cut idea of what is meant by "thermodynamics," but he knows how to make that plant run on the least possible number of B.t.u. His language and appearance are not of the most polished, but he talks the language of the power plant intelligently and makes it say things; and what he may lack in upkeep and grooming is compensated by the spick-and-span condition of his plant and the state of inspected readiness of everything depending upon his supervision. His men regard him as a master of power-plant engineering; and he is, quite as much so as many whose names are painted upon the doors of consultant offices.

In looking about the plant a situation was disclosed where a considerable saving could obviously be made by a simple change in practice. This change, however, involved an expenditure for equipment which required the approval of those higher up; and this approval the chief could not get.

The advantage of the change was so apparent, the return upon the necessary investment so certain and so considerable, that the editor ventured to express the doubt that was in him as to the convincingness with which the proposition had been presented, which brought out the response:

"I presented it all right, but they had seen me in my working clothes."

There is a whole lot of human nature in that response and in the situation.

If the existing condition had been described to the president or board of directors by a professional engineer of impressive appearance, accustomed to meeting men of this class in a concise and convincing brief, it would probably have been adopted.

Too many men having the power of decision in such cases pay more attention to the source of such a recommendation than to its merits.

They are often incapable of weighing the advantages and disadvantages of a proposition and subjecting it to an engineering analysis, but they are very susceptible to the impressions aroused by the appearance and position of the one who suggests it; and if these impressions are not satisfying and impelling, they will combine with inertia and the natural reluctance to spend money, in producing an unfavorable reaction or a failure to act at all.

Too many of us fail to detect the diamond in its rough casing—to value an idea at its true worth because of the channel by which it reaches us. The men whose devotion to exacting practical work has kept them isolated and diffident about making advances to their superiors in authority are, by their very association with the intimate details of their plants and their operation, full of ideas for their betterment.

They would be more so if they were given some encouragement in their consideration. It is a wise superior with the taste of whose cigars these men are familiar.

Preventing Elevator Accidents

MUCH has been accomplished in industries toward accident prevention by the installation of proper safeguards and educational safety propaganda, but there still remains a great deal to be done. Passenger and freight elevators contribute their quota each year to the accidents of the country, notwithstanding it is possible, by the use of safety devices, to prevent ninety per cent of all accidents. Why the installation of these devices has not been made mandatory by state law throughout the country may be accounted for in the same way as the lack of suitable boiler laws and other statutes for public safety in many of the states.

Statistics have shown that at least seventy per cent of all elevator accidents occurring to persons traveling on passenger and freight elevators happen in connection with the opening to and from the elevator shaft. In states where elevator hatchway and car doors must by law be equipped with suitable and effective interlocks so that the car cannot be started until all doors are closed and locked, injury to persons entering and leaving elevators is practically unknown. Nevertheless, in spite of the proved effectiveness of door interlocks in preventing accidents at elevator landings, few states require by law their installation. Accidents due to the elevator car falling have been practically eliminated by the installation and maintenance of proper safety devices, so much so that the modern passenger elevator is the safest means of transportation. Is it not about time to give a little less thought to the cost of installing and maintaining interlocks on elevator-shaft doors and more to the accident-prevention possibilities of these devices and make it mandatory by law that all elevator doors must be so equipped?

Proper Alignment of Electric Motors

IN THE application of an electric motor no feature is of any greater importance than the proper installation of the machine. Not infrequently, the purpose of proper design, good workmanship and materials and correct application have been defeated by poor installation.

Good installation includes the proper foundations, alignment and high-grade wiring. Misalignment of the motor to the machine it is driving, if gears are used, will cause excessive wear on the gears and bearings, even breaking of the gears and vibration. This vibration will be transmitted to the current-carrying parts of the motor and will result in unending electrical troubles. With chain or belt drive, although there will not be the vibration transmitted to the motor as with gear drive, there will be excessive wear of either the belt or chain. The latter in particular is expensive.

There may also be caused an excessive end oscillation of the armature which will result in electrical troubles. Strange as it may seem, once a motor is installed out of line it is in general a long time being rectified, those responsible apparently being willing to struggle along with the mistakes of the past.

The proper alignment of a motor with the machinery is not a difficult job even when the former is mounted on the ceiling, as in shown by K. A. Reed in the article, "Lining Up a Motor for Shafting or Machine Drive," in this issue. From Mr. Reed's explanations the solution of the problem may be reached by applying a few well-known principles, and is not a hit-or-miss proposition. It is so simple that one wonders why there are so many motors out of line with the machinery they are driving. As Mr. Reed points out, it is not enough that the center of the drive on the motor line with the center of that on the driven machine, but the motor must be level on its foundation. Foundations out of level cause the rotating element to tend to pull out of the magnetic center, resulting in oscillation that frequently causes trouble. When the motor is mounted on the ceiling, it offers the most difficult problem of alignment, but this resolves into a careful laying out of a few lines on the ceiling, after which the foundation is easily located. In fact, the most difficult part of the job is getting the motor in position after the foundation has been put into place.

President Wilson's prompt and firm refusal to reopen the award of the Anthracite Wage Commission is to be heartily commended and, it is believed, will meet with general approval. The point at issue was that of holding to an agreement and not a question of whether the award was adequate. Both the miners and the operators had agreed in advance to accept the findings of the commission, in the personnel of which they had equal representation. That the award did not meet the expectations of some of the miners is unfortunate, but if adjustment of disputes by properly constituted commissions are to amount to anything their decisions must be accepted; otherwise we are likely to be involved in constant industrial turmoil. On the other hand, the miners must be shown by the President that he intends to deal as firmly with the operators and coal dealers in the prosecutions recently undertaken by the Department of Justice.

In this issue W. D. Forbes, under the heading, "Reminiscences of an Engineer," tells of some of the early work of Baxter, Stevens, Allen and Corliss. One is accustomed to live so much in the present as to lose sight of the advances that have been and are being made in engineering practice. It is indeed a privilege, therefore, to occasionally meet with someone like Mr. Forbes, who can take us back to intimate association with these pioneers in steam engineering.

There has been considerable discussion during the last two or three years on the advisibility of installing turbo-alternators in extremely large sizes. However, be the weight of the argument for or against such machines, evidently the large operating companies retain their confidence in them as demonstrated by the orders placed for this class of equipment.

CORRESPONDENCE

Water Hammer in Elevator Pressure Lines

In the Aug. 17 issue of *Power*, page 267, Mr. Ryan speaks of trouble caused by too much vacuum in the suction line of an elevator pump with only about 7 ft. in length lift, some of the discharge lines being as much as 1,500 ft. long.

The sketch does not show a stop valve or foot valve in the suction pipe, which brings the weight of the lift on the pump suction valves. The old air-inlet valve, described as being connected to the discharge and suction pipe, would appear to be an arrangement for priming as well as an air inlet. The absence of an air-cushion chamber on a pump of such size is somewhat of a handicap, but one could be made out of 4- or 6-in. pipe and connected to the top of the discharge chamber to help steady the flow through the 1,500-ft. lines.

I have had similar troubles with the discharge lines to the tanks, although they were not so long. I have never seen the time that I could get too much vacuum in a pump to lift water, for the highest possible vacuum is 30 in. and the theoretical lift of water is 34 ft., which is difficult even if the pump is primed. I have seen pumps run so fast that the water could not follow the piston and thus caused a break between the water volume in the suction pipe and the piston in the pump cylinder, which made the piston bound forward, after pulling steadily for a few inches of the stroke, with a snapping pound much resembling water hammer in a steam pipe. Anyone not familiar with this sound and some who are would think at first that the pistons were loose.

It is most likely, judging from the illustration shown, that the suction strainer on Mr. Ryan's pump became corroded and choked, having been shut down all summer, by the grease from the elevator machines mixed with ground fiber of the packing, getting into the return and collecting on the strainer.

If such is the case, it would cause the pipe lines to vibrate through to the pressure tanks. I think that putting a vacuum breaker on the suction line, which allowed air to enter, partly broke the vacuum and stopped the hammer in the pump and also eased off the thud sound in the discharge-pipe line by giving a little air cushion to the pipe and building up a larger air volume in the pressure tank, which aided much to relieve the obnoxious sounds. The pressure tank should not contain either too much water or too much air. Had Mr. Ryan continued to make use of the old air-inlet valve on the suction pipe, he probably would have obtained the same result that he did with the new air valve. That the pump lost its water so easily leads one to believe that the suction valves or springs, or both, were badly worn and that the valves were leaking.

A small air leak in the suction line would not cause failure of operation, because if the suction valves were tight air could not get back through them when water-sealed, and it would be forced up through the discharge valves with whatever water passed through them. Such a leak would have given the same result as the vacuum breaker or air-inlet valve. If the suction valves were tight, the pressure on the discharge valves would keep them water-sealed and the air would escape where there was least resistance, through the suction valves. This would give a tremendous hammer from the pump to the tank each time the piston reached the end of the stroke. If the pump was able to retain its priming and pump any water, the pressure in the tank would slam the valves down hard on the discharge and on the suction-valve seats as the pistons passed the ends of the stroke.

All such pumps will slam and hammer when started up, just as the cylinders begin to fill with water, because a long suction pipe contains a large volume of air which should be allowed to escape through the drip on the dicharge chamber before the pump is put in service, and as the pump is running a little fast on a high lift, it should be throttled down some to prevent possible breaking of valve bolts or stretching the piston rods where they pass through the water pistons.

Cambridge, Mass. R. A. CULTRA.

Testing Governor and Valve Adjustment

In the Aug. 24 issue of *Power*, p. 307, C. W. Peters speaks of the danger of having the valves and governor of an engine so adjusted that the speed will not be controlled in case of the main belt breaking or the engine otherwise losing its load.

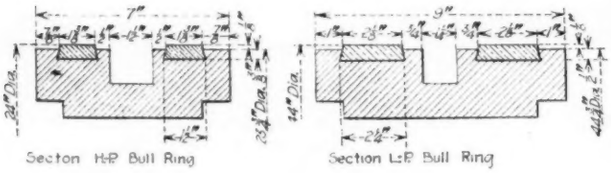
The governor and valve adjustment is easily proved by forcing the governor against the top collar and taking an indicator diagram while in this position from one end and then, after the speed has steadied down, indicating the other end of the cylinder. The valves should show no opening, or at least the retarding force shown by that part of the diagram below the atmospheric line should be equal to or greater than the part above the line. J. O. BENEFIEL.

Anderson, Ind.

Red Metal in Steam Engine Pistons

On page 95 of the July 20 issue of *Power*, Mr. Hamkens says, in that part of his article relating to the use of red metal in steam-engine pistons, that it is not feasible to allow the red metal to project $\frac{1}{32}$ or $\frac{1}{16}$ in. above the face of the piston with the idea of supporting the piston solely on the soft-metal strips, as the latter wear down in a short while and allow too much play between the bull ring and the cylinder walls.

The accompanying drawing shows a section through



SECTION THROUGH HIGH- AND LOW-PRESSURE BULL RINGS

the bull rings of two 24 and 44 by 42-in. cross-compound engines that have been in service for the last twenty years direct-connected to 500-kw. generators. We have never had trouble with these pistons due to the $\frac{1}{4}$-in. projection of red metal shown. In fact, the soft-metal strips always outlive the steam-packing ring, and their value is shown by the fact that the cylinders have never been rebored and have worn less than $\frac{1}{16}$ in. from their original diameter.

ADOLPH QUADT.

Perth Amboy, N. J.

Where Should the Beginner Start?

In *Power* of Aug. 10, page 229, J. A. Lane asks the question, "What has become of all the first-class firemen within the last five years?" and says he believes this to be a pertinent question. It is. Have these fellows been promoted to the engine room, or have they gone into more lucrative jobs?

The attractive wages offered in production work during the late war lured many a man from his old-time job, and the man in the fire hole certainly was not an exception. However, conditions are now undergoing a great change, the labor market has eased up, fabulous wage rates are no longer being offered, but will be based on the ability to produce.

On the other hand, the price of coal has steadily gone up, so that today the economical use of fuel is of paramount importance. In consequence it may be that experienced firemen who found it advantageous several years ago to leave their jobs, may now find it just as much to their advantage to seek positions in the boiler rooms.

Mr. Lane, in his suggestion that young men be started in the engine room, with the view of later promoting them to the boiler room, voices the trend of the present day. In production plants the purchasing, storing and handling of raw material through the various producing operations into finished salable product are constantly being studied by experts with a view of reducing waste and holding the cost of finished product to a minimum. Production methods are being applied in the boiler room in converting the potential energy in the fuel into such form that it may be useful for heat, light or power applications.

It might be well to more or less definitely settle the question, "What is a fireman?" Is he a coal heaver, combustion engineer, boiler-room manager, water tender, etc? Let us have opinions as to the qualifications of a first-class fireman.

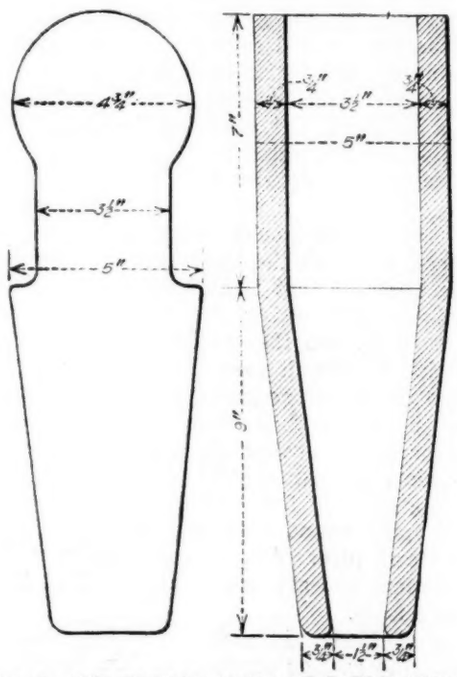
J. B. CLAPPER.

Cleveland, Ohio.

Socketing Hoisting Cables

The Spring Valley Coal Co. has practiced the Riebling system of socketing hoisting ropes with zinc for the last fifteen years, and it has given excellent results, as described in the article "Reserve Strength of Elevator Ropes," by W. Voightlander, page 115, *Power*, July 20, 1920.

It is our practice to resocket the hoisting ropes every six months. Our socket for $1\frac{3}{8}$-in. ropes, shown in the figures, was designed by the writer and is made in steel casting. It will be noted that the basket is made longer than is usual practice and the lugs are far enough apart to allow the zinc casting to pass between them. When we wish to remove the zinc, we cut the wires off close to the top of the basket with a hacksaw and back out the zinc with a punch and sledge. This saves heating the socket and adds to its life. In ordering sheave wheels, it is our practice to order them grooved for $1\frac{1}{2}$-in rope and then use them on $1\frac{3}{8}$-in. rope.



PLAN AND SECTION VIEW OF CABLE SOCKET

This gives plenty or room, and we never have trouble with a new rope binding in the groove.

A. H. HALLADAY,
Master Mechanic Spring Valley Coal Co.

Spring Valley, Ill.

[Mr. Halladay's letter is interesting and should prove valuable to many *Power* readers. From the number of inquiries received, there is apparently considerable difficulty experienced with wire cable on both elevators and mine hoists. To promote an exchange of experiences, *Power* would appreciate articles for publication, on the practice of a number of its readers in maintaining and socketing hoist cables.—EDITOR.]

Valve Cam Worked Ahead

A rather peculiar thing has happened to one of my double 30 x 60-in. engines, developing a maximum of 2,500 hp. All valves are actuated by cams, and one cam has slipped ahead. No. 1 diagram was submitted to me first. The assistant engineer was instructed

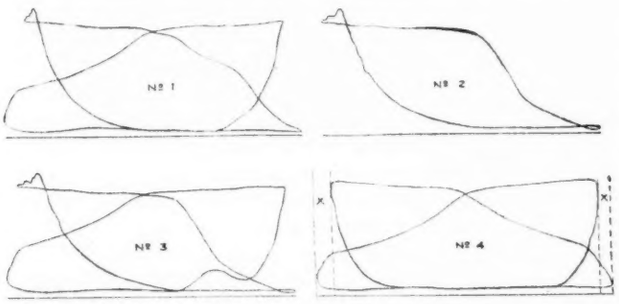


DIAGRAM NO. 1, CAM SLIPPED, KEEPERS OPEN; NO. 2, RESULT OF MORE CAM SLIPPAGE; NO. 3, CRANK END GETTING BACK TO POSITION; NO. 4, BOTH ENDS APPROXIMATELY CORRECT

after shutting down at 5 p.m. to turn the head-end exhaust cam back to the mark, as it was ahead.

Half an hour after shutting down, No. 2 diagram was submitted, with the remark, "She's pounding." Then the diagram, No. 3, was taken, the assistant remarking that "the other end was now on the 'bum,'" and that the compression had gone "dippy."

I suggested that when the head-end exhaust cam had been adjusted the crank end would take care of itself. No. 3 diagram shows that the exhaust opened so quickly that it built up the back pressure on the crank end, making it look as if the crank-end exhaust had started to close and build up compression, losing it a second later, then picking it up again. It was the exhaust line in general, as the back-pressure gage would have shown had the engineer looked closely.

Single indicator cocks are used, and one motion is just a trifle longer, making diagrams overlap as marked at *X*, No. 4. The next diagram looked as if the cam had been put back in place, but the compression on the head end was just a trifle off. Diagram No. 4 shows that all trouble has been eliminated.

It will be observed that there is some load on this side of engine. That cam was approximately 72 deg. ahead, not 288 deg. back of the crank. We caught it on the way ahead as Nos. 1 and 2 prove. If an eccentric slipped ahead it would cause some discussion!

New York City. C. W. PETERS.

Trouble with Split Eccentric

On a certain engine the eccentrics *A* and *B* are set close up to the end of the main pillow block. The governor pulley *C* was made a part of the exhaust eccentric, and all three were of the split type so that they could be taken off the shaft at will. They were held in position by two setscrews *D* without a key to keep them from slipping, a common occurrence unless the setscrews were tightened every week.

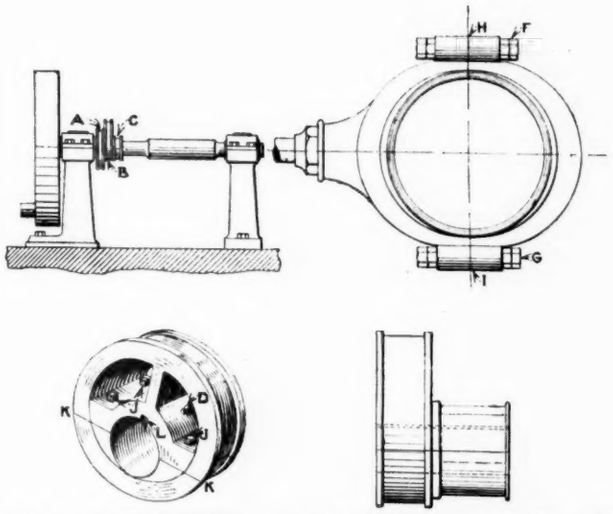
The real cause of their becoming loose was that the shaft was out of level about $\frac{1}{16}$ in. and had an end thrust of $\frac{3}{8}$ in., which caused the eccentrics, which also served as a collar to prevent the end thrust, to bump hard against the main bearing. This threw a strain on the bolts holding the two halves of the eccentrics together, which caused the nuts to give slightly until the setscrews were loosened. One not familiar with this action would naturally tighten the setscrews to hold the eccentric from turning on the shaft. This left the rim bolts still loose, and in the revolution the eccentric would rock on the setscrews.

The steam eccentric caused the most trouble, as it not only carried the heavier load, but was between the exhaust eccentric and the end of the bearing, and but one setscrew could be tightened with a wrench; with care the other was tightened with a cold chisel, but the rim bolts had not been tightened and of course the eccentric was expanding, so to speak, until the eccentric strap ran hot. Someone had loosened the bolts *F* and *G* until there was a looseness at *H* and *I*, and this space grew wider and the eccentric continued to run hot. It was thought best to put a shim in the strap at *H* and *I*.

Other troubles made it necessary to remove the eccentrics from the shaft, and when the faces of the rims were cleaned the bolts *J* were easily tightened while the cap was off the bearing. When the setscrews *D* were set up tight, it was found that the eccentric strap could be clamped tight and still swing loose on the eccentric, and shims at *H* and *I* were not needed.

The split at the center line of the shaft is represented by *KK*, and dirt prevented the bolts *JJ* from bringing the two surfaces together properly. Had a keyway been cut at *L*, the eccentric could not have turned on the shaft.

The end thrust of the shaft reached its greatest throw during heavy loads for the reason that at such times



HOW THE ECCENTRICS WERE MADE AND PLACED ON ENGINE SHAFT

it would get in phase or step with the pull and push of the piston on the crankpin, which added force to the thrust and caused sledgehammer blows of the crank disk and eccentrics alternately against the ends of the bearings. Had there been a slight shoulder turned on the shaft to fit against the end of the bearing, the setscrews would not have been hammered loose in their spot position on the shaft, and the rim bolts would not have worked loose so easily. The end thrust was removed by leveling the shaft and setting the eccentrics closer to the main bearing. R. A. CULTRA.

Cambridge, Mass.

Fuel Waste Causes Failure of Central Heating Station

A certain central-heating station, supplying steam and hot-water heat, had been in operation for eight years. In spite of the fact that the plant was well designed, that capable engineers had been in charge of the operation and that the location was ideal for a heating plant, it had never paid. No less than eight engineers had been in charge. Each one had gone away thoroughly disgusted, leaving the plant in a worse condition than when they assumed charge. Finally a combustion engineer was employed and placed in charge of the operation and management. He was told of the failure of his predecessors and asked to locate and remove the cause of the previous failures. He was assured that he would have the full co-operation of the management in his efforts to right things. With this assurance and a strong determination to succeed where others had failed, the combustion engineer assumed charge. To locate the trouble was a very simple matter, but to remove it was a different undertaking.

The steam-generating equipment consisted of three 400-hp. vertical water-tube boilers, each having 4,000 sq.ft. of heating surface, and one 600-hp. water-tube boiler having 6,000 sq.ft. of heating surface. Three boilers were set in a single battery and were served by side-feed stokers, each having a grate area of 88 sq.ft. The other boiler was served by a chain-grate stoker having an area of 96 sq.ft. Coal was furnished to the side-feed stokers from bunkers directly on top of the furnaces in the usual way. The coal was supplied to the chain grate from an overhead bunker. Coal was delivered to the bunkers by a drag-chain conveyor, which was in turn supplied by a track hopper 200 ft. from the boiler room. Feed water was heated by a 3,000-hp. open feed-water heater and delivered to the boilers by two 9 and 10 by 12-in. duplex pumps, without governors or regulators. No means were provided for controlling the drafts except by hand.

Upon examination of the boilers it was found that the scale was no less than $\frac{3}{16}$ in. thick and in some instances the tubes were completely stopped up with mud and scale. The tubes were burned and blistered until it would not do to try to scale them as the turbine would cut through the metal, the tubes were so thin. It was evident that new tubes would have to be put in.

The flue-gas temperatures were found to range around 1,000 deg. F., owing to the scale in the tubes, the broken-down baffles and the soot on the outside of the tubes which was $\frac{1}{16}$ to $\frac{1}{8}$ in. thick and on the tubes next to the fire ashes were fused on them until the gas passage was almost stopped up. No mechanical means for cleaning tubes had been provided, a hand lance being depended upon. This was seldom if ever used, as the condition of the tubes proved.

The side-feed stokers were found in a dilapidated condition, the bearing bars were burned until they had sagged and allowed the grate bars to slip off of the upper bearing bar, thus allowing coal to fall from the coking chamber directly into the sifting pit. The grate bars were badly burned and warped, and the arch plates had warped and sagged to such an extent that the feeding mechanism would not operate; consequently coal had to be fed by hand, using a rod to poke it down. This, of course, required extra labor. After thorough examination it was seen that to repair these stokers would cost as much as new ones and then the plant would not be very well off in so far as stokers was concerned.

Next, the chain grate was examined, and it was found to be in but little better condition than the other. A large number of the links were broken out of the chain which allowed coal to fall into the sifting pit in large quantities. The front driving-sprocket shaft was bent so badly that the stoker engine would hardly drive the chain, and the driving gears would hardly stay in mesh. This was caused by allowing the center bearing to become loose and fall out. One of the side frames was broken as well as one of the cross-braces.

The settings were next examined, and they were found full of cracks and holes, which allowed excess air to get into the furnace where it was not wanted. The furnace linings were all loose from the outside walls and were leaning over against the boiler. No less than 250 leaky flanges and joints were found in the steam piping.

The records showed that the average life of an arch for the side-feed furnaces was three months, even though the boilers were not worked over rating. The coal for these boilers was supported by these arches, which at times amounted to as much as twenty tons.

After a thorough examination of the equipment and an analyses of the conditions had been made a report was sent to the management who had pledged their co-operation. The engineer was asked what he was going to do about it. After due reflection and consideration, an estimate of the cost of rehabilitation of the boiler plant was made, together with recommendations for improvements which were necessary to make before anything like economical operation could be obtained. It was shown that the cost of the improvements, which included three new stokers to replace the side-feed and repairs for the chain-grate stoker, mechanical soot cleaners, draft-control apparatus and other necessary supplies would be paid for in less than one year by the savings effected in fuel and labor.

The engineer was informed that until the plant had been made to make its own way, no money would be spent for improvements. It was found that the labor had been cut down until not enough men were employed to keep up the necessary work about the plant. The engineer then put some extra men on the payroll to clean up the boilers and make the best out of what he had on hand. These extra men were to scale the tubes and put in new tubes where necessary, keep the tubes blown clean and do whatever was required around the plant. The management then offered their assistance again and informed the engineer that no extra men would be allowed as the plant was not paying expenses.

The engineer tried to explain that a $3 per day man who would save several tons of $8 coal per day was a good investment and was a good way to make the plant pay dividends. The engineer was told that he was just like those that had come before him, that he was wasteful, extravagant and that his ideas were all wrong.

Seeing that the task was hopeless unless the management would allow him to spend the necessary money to put the plant in condition, he appealed to them numberless times and meeting with the same rebuff each time, finally became disgusted and went away.

Three months later the company went into the hands of a receiver. The management is wondering why.

Logansport, Ind. WILLIAM M. MCNEILL.

INQUIRIES OF GENERAL INTEREST

Heat of Water and of Steam—Does a pound of water contain as much heat as a pound of steam in the same boiler? R. R.

The water and the steam in presence of the water are of the same temperature, but a pound of the water does not contain as many heat units as a pound of the steam, because conversion of the water into steam requires addition of the latent heat of evaporation.

Changing from Condensing to Non-Condensing—What changes of valve setting should be made when changing from condensing to non-condensing? J. R. S.

For running non-condensing the exhaust valves should be closed later because less compression of the higher-pressure exhaust will be necessary for obtaining the same cushioning effect. With a Corliss valve gear less compression should be obtained by setting the exhaust eccentric backward. With a single-eccentric engine it will be necessary to set the eccentric backward, and to preserve the same lead, the steam valves must have less lap when the wristplate is in its central position.

Scaling-off of Poor Galvanizing—What preparation can be used as a coating to prevent galvanizing from scaling-off iron pipes? J. J. C.

Ordinary galvanizing is a coating obtained by dipping the pipe or other article in a bath of molten zinc. If the zinc shells off, it is because the article when galvanized was not properly prepared or the temperatures were not suitable, and no preparation applied as a coating over the zinc that is already loosened could be of benefit for increasing its adhesiveness. A coating like paint or asphaltum would act as a binder until it became dry and brittle, but would be thrown off along with the galvanizing in places where the zinc has not taken good hold on the pipe. For improvement of appearance of the exterior and protection from rusting, remove all galvanizing possible to be rubbed off with a sharp coarse file and give the pipe a coat of aluminum paint.

Allowance for Moisture in Rating Engine Economy—In determining the economy of reciprocating steam engines expressed in pounds of steam per indicated horsepower-hour or per brake horsepower-hour, how is allowance to be made for the quality of the steam supplied? A. E. M.

Unless otherwise particularly specified, reciprocating-engine economy is assumed to be based on a supply of commercially dry steam, that is, steam containing not over 2 per cent moisture, and the quantity of steam charged as consumed is determined by deducting the moisture, if any, found by calorimeter test, from the total amount of air-pump discharge or complete condensation of exhaust discharged. If the steam is superheated, no correction is to be made for the superheat. When the steam supply is of poorer quality than 98 per cent dry, the moisture is more detrimental to economy than the percentage present, on account of reduction of the expansive force of the dry portion of steam by heat absorbed in evaporation of the moisture, and also because the losses from radiation are increased owing to greater conductivity of heat by wet steam than from dry steam coming in contact with the walls of the cylinder and steam passages.

Variation in Length of Indicator Diagrams—What causes difference in length of indicator diagrams taken with the same indicator and reducing motion from opposite ends of an engine cylinder? J. B. S.

Different lengths of diagrams may result from use of indicator cords of different diameter or a different winding or building up of cords on the reducing motion or sheave of the paper drum. There will also be a shortening of the diagrams due to stretching of the cord or insufficient drum-spring tension to overcome the drum and pencil friction.

Economical Limit of Vacuum for Reciprocating Engine—Why is more than 26 inches vacuum considered uneconomical for operation of a condensing engine? W. T.

Under ordinary conditions, when the exhaust is condensed to a pressure below 26 inches vacuum, which would be about 2 lb. absolute and 126 deg. F., the greater cylinder cooling due to the lower temperature of the exhaust, that must be compensated by heat abstracted from the initial steam, amounts to more loss than the increase of m.e.p. obtained by the further reduction of back pressure, aside from additional cost of obtaining a higher vacuum.

Alternators in Parallel—We have two crude-oil engines, each rated at 25 hp., which we want to belt to alternating-current generators of whatever size the engines will drive. It is desired to operate the alternators in parallel. Can this be done? Would there be any advantage in belting both engines to a lineshaft and driving the alternators from this shaft using clutches on the engine pulleys? W. L. H.

It would not be good practice to belt the two oil engines to the same lineshaft. This has been tried a number of times but without success. There is no reason why an alternating-current generator cannot be belted to each oil engine and have the generators operate in parallel. Alternating-current generators, to operate in parallel successfully when driven by these oil engines, will require squirrel-cage windings in the pole faces.

Unstayed Heads of Steam Drums—Why are not heads of steam drums of water-tube boilers stayed? J. N. R.

When unstayed, the heads are bumped. When a head is bumped or dished to the form of a spherical segment, most of the material is subjected only to a tensile stress such as would occur if the segment were part of a complete hollow sphere of the same radius of curvature and subjected to the same pressure, without requirement of stays to preserve a spherical form. However, when the pressure is on the concave side and the head is not a complete hemisphere, the pressure tends to distort the material to a hemispherical form at the periphery where the original form is a sudden change of shape from the spherical form to the cylindrical form of the flange. This gives rise to a dangerous bending action which must be prevented by staying or more usually is met by the thickness of the material. To guard against this weakness, where the heads are assumed to be of the same thickness throughout, conservative formulas for determining the thickness of unstayed bumped heads for a given working pressure result in providing greater thickness of material than would be necessary for obtaining sufficient strength for the central spherical portion of the head.

The Storage of Bituminous Coal*

By O. P. HOOD†

THE general subject of coal storage gives one a large field within which to wander. The best current storage practice is well illustrated in a publication issued by the Engineering Experiment Station of the University of Illinois under the title, "The Storage of Bituminous Coal," by H. H. Stoek. A short résumé of the subject is given by the same author in Bureau of Mines Technical Paper 235, copy of which forms an appendix to this paper.

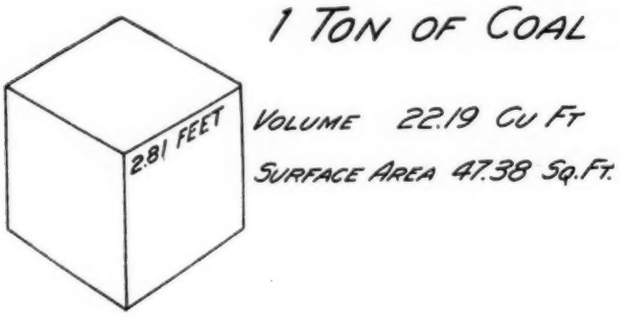


FIG. 1. VOLUME AND SURFACE OF ONE TON OF COAL

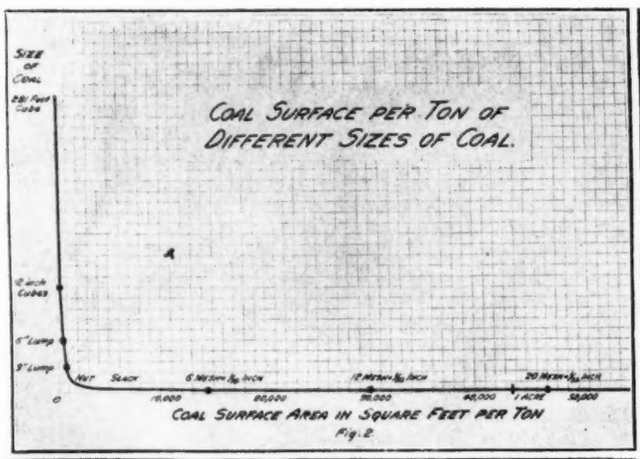
*Address before Pennsylvania Electric Association, Bedford Springs, Pa., Sept. 10, 1920.

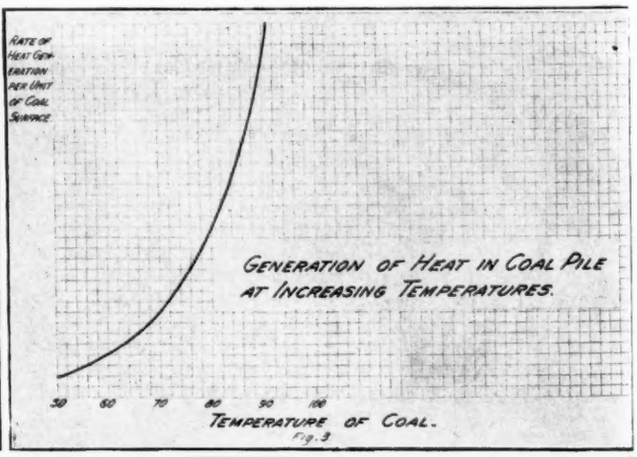
†Chief mechanical engineer, United States Bureau of Mines.

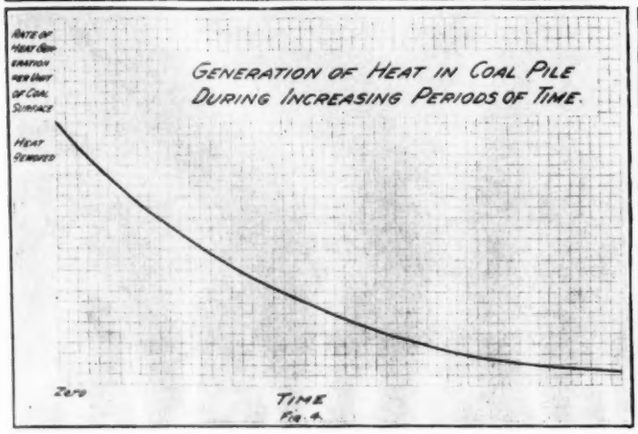
The spontaneous combustion of coal lies at the bottom of the subject of storage. Every engineer is familiar with the phenomena of the self heating of coal. For all that, the phenomenon is a relatively rare one. If we counted the times a portion of coal was stored where it would be undisturbed for a few weeks, the number of such storage operations in any one year would mount into the millions. Of these a relatively small number show the phenomenon of spontaneous combustion and the risk per ton is very small. In the smaller operations involving but few tons it is extremely rare that there is any heating of coal. There is no spontaneous combustion of anthracite, and very rarely does the domestic consumer of bituminous coal find troublesome heating.

The main interest in the subject lies in the large piles needed for reserve for public-service utilities and the industries.

Everyone desires to have a perfectly simple direction for storage which will insure against loss. Unfortunately, the matter is too complicated for a simple solution. Many of the factors involved are difficult to determine, as we have no practical means of quantitative measurement. The factors involve chemistry, physics and engineering, and the man who is in close contact with the problem of stored coal is not always a good observer in these several lines. The result is many incorrect theories, opinions and prejudices. It will be my attempt to try to picture to you some of the main factors in the problem so that a working theory may be held and observation centered on the essential factors.






RATE OF HEAT GENERATION PER UNIT OF COAL SURFACE
HEAT REMOVED
GENERATION OF HEAT IN COAL PILE DURING INCREASING PERIODS OF TIME.
Zero
TIME
Fig. 4.

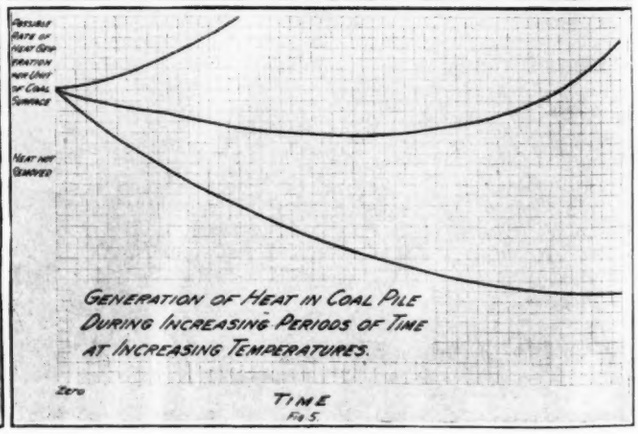

POSSIBLE RATE OF HEAT GENERATION PER UNIT OF COAL SURFACE
HEAT NOT REMOVED
GENERATION OF HEAT IN COAL PILE DURING INCREASING PERIODS OF TIME AT INCREASING TEMPERATURES.
Zero
TIME
Fig. 5.

FIG. 2. COAL SURFACE PER TON OF DIFFERENT SIZES OF COAL. FIG. 3. GENERATION OF HEAT IN COAL PILE AT INCREASING TEMPERATURES. FIG. 4. GENERATION OF HEAT IN COAL PILE DURING INCREASING PERIODS OF TIME. FIG. 5. GENERATION OF HEAT IN COAL PILE DURING INCREASING PERIODS OF TIME AT INCREASING TEMPERATURES

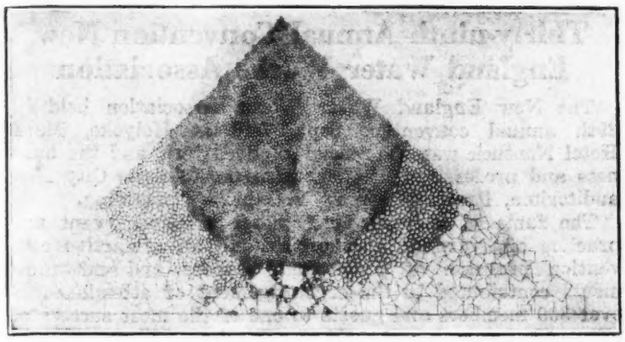


FIG. 6. SEGREGATION OF DIFFERENT SIZES OF COAL IN A CONICAL PILE

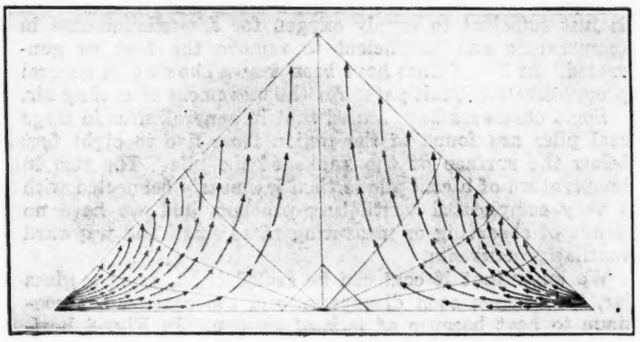


FIG. 7. LINES SHOWING INCREASINGLY DIFFICULT PATHS FOR AIR CIRCULATION

I remember reviewing a case involving spontaneous combustion on shipboard where in the hearings everything had been investigated from the pennant on the mast to the barnacles on the rudder, but the observations that had a real bearing on the heating of the coal were extremely few and formed a very unpretentious part of a formidable looking document. It is necessary to know what to look for in order to draw reasonably accurate conclusions.

The heating of coal is believed to be a surface phenomenon. If a ton of bituminous coal could be delivered in a single cube, Fig. 1, each dimension would be about 2.8 ft. If the coal heats, it is due to something that goes on with respect to the surface and not something that happens inside of the piece. So far as we know, this is true no matter how small the piece is divided. We are, therefore, interested in the amount of exposed surface in a ton of coal. If this cube, having originally about 47 sq. ft. of area, be continuously subdivided, the rate of increase in the exposed surface is shown in Fig. 2. If the size is reduced to something about 16-mesh screen, there is an acre of exposed coal surface. It is perfectly obvious from this why it is that trouble from spontaneous combustion originates in fine coal, because the great increase in extent of surface does not begin until we get below 1¼ nut. If fine coal is kept out of the pile, the heating is so relatively small as to remove the cause of spontaneous combustion. This remark applies not to the fact that one may buy lump coal, but to what actually gets into the storage pile. Coal bought as lump at the mine and handled with modern disregard for breakage may be far from lump coal when in the pile.

Heat Generated Depends on Temperature of Coal When Stored

A unit of area of this coal surface generates a certain amount of heat provided it can find combining material. The amount of heat generated depends upon the temperature of the piece of coal. That is to say, coal put into storage at a temperature of 80 deg. will generate very much more heat per unit of surface than if put into storage at the temperature of 60 deg., Fig. 3. I cannot say just how much more, but the chemists tell us that in general the rate of chemical reaction doubles for every 10 deg. rise in temperature, and if that applies in this case, beginning at 20 deg. higher in temperature means a fourfold increase in the amount of heat generated. It has already been a matter of observation that coal stored during the hot months of summer and in heated areas is much more liable to spontaneous combustion than coal stored in colder climes and in cooler portions of the year.

Another important factor is the freshness of the broken surface. A freshly broken surface of coal has a rate of heat generation that is a function of the kind of coal. It is practically zero with anthracite and is largest with the younger coals. The quantity of oxygen contained in the coal seems to be the fairest measure of this rate, although by no means reliable. The high-oxygen coals of the Middle West and the sub-bituminous coals and lignites of the West show increasingly active rates of heating.

The coal surface apparently becomes satisfied in time, and the heat produced falls to practically zero. The rate of heating then follows along a curve somewhat like that given in Fig. 4. This means that for the first few days or weeks a freshly broken surface is very much more active than after a few weeks or months. This fact must be borne in mind when the question is considered as to whether it is wise to crush coal immediately before putting it in storage. Fires rarely occur after surfaces have been exposed for three months.

Since the rate of heating increases with the temperature, it is evident that if the heat generated is not removed, the process becomes a self-aggravating one, in which case the rate of heat generation, instead of falling as in Fig. 4, may rise with time according to some curve as shown in Fig 5. If the temperature of the pile reaches 140 or 150 deg. and continues to rise, there is a very considerable probability that within a few days or a few weeks, a destructive temperature will be reached and the coal must be moved. Immediately the question of getting rid of the heat is presented.

A coal pile is cooled by radiation and by movement of air through the pile. Air moves rather freely through a coal pile. In a certain case a partial cargo of coal was loaded into a bottom at New York and proceeded under sail to Norfolk. The general temperature of the pile at loading was known and on arrival at Norfolk the coal had so increased in temperature as to make it dangerous to add further cargo. Knowing the rise in temperature of this mass, it was possible to roughly figure the exchange of air that must have been made within the coal pile, in order to supply the amount of oxygen represented by the heating effect. The general order of magnitude was that all of the air in the interstices between the pieces of coal must have been changed from twenty to thirty times during the time of heating. This coal was, of course, protected from winds, and Fig. 6 shows the amount of the natural ventilation within a coal pile, due to differences in temperature and the daily variation of barometric pressure. In many cases this natural change, or breathing of air, is enough to carry away the heat generated.

Smaller Pieces in Central Core of Pile

Suppose that coal was delivered in four uniform sizes and put in a conical pile by dropping at a single point. The granular arrangement of parts would be such as to furnish a foundation, over nearly the whole pile, of larger-sized pieces, and the lower flanks of the pile would be of the larger sizes. Nearly all of the smallest pieces would be in the central core of the pile. If one were to draw lines bounding the regions of these several sizes they would be something like those shown in Fig. 6. In the region of large pieces air would move freely and the coal surface exposed would be a minimum; hence there would be little likelihood of heating. In the center of the pile the movement of air would be small, while the amount of heating surface would be great. If the fine coal is so densely packed as to prevent an exchange of air, there will be no heating because there will be no supply of oxygen to combine with the active surfaces. Somewhere between the two extremes of the central core of fine coal and the large-piece region, there may be areas where the ventilating current

is just sufficient to supply oxygen for a maximum rise in temperature and insufficient to remove the heat as generated. In Fig. 7 lines have been drawn showing in general progressively difficult paths for the movement of cooling air.

Some observers have stated that in general, fires in large coal piles are found in the region from five to eight feet below the surface on the flanks of the pile. The rise in temperature of a coal pile is then intimately connected with a very complicated ventilating problem, and we have no means of observing or measuring these small and wayward ventilating currents.

We know that if coal can be sealed tight, as in a glass jar, the oxygen soon disappears and the coal cannot continue to heat because of lack of oxygen. In Fig. 8 horizontal distances represent the amount of ventilation of any portion of a coal pile and vertical distances represent rise

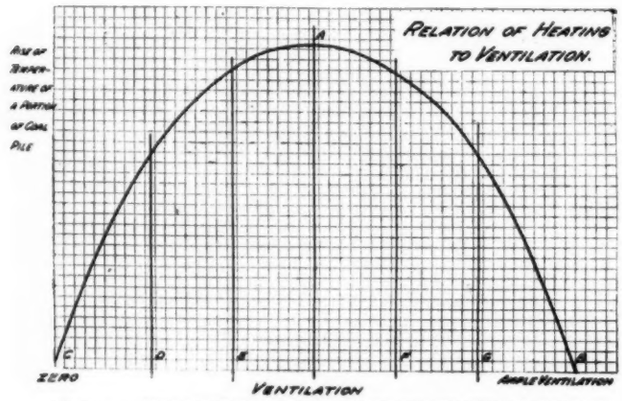


FIG. 8. RELATION OF HEATING TO VENTILATION

in temperature. With no ventilation there will be no rise in temperature and the zero point will represent the condition of coal sealed from the air or so densely packed that air cannot circulate. If, on the other hand, there is sufficient ventilation, the heat is all carried away as fast as generated and some point, as at *B*, on the zero line must represent this condition, as in the case of coarse coal. At some point, as at *A*, between these two extremes there may be a condition of ventilation that will supply just oxygen enough to provide for a maximum rise in temperature.

What sort of a curve represents all the intermediate conditions between *C*, *A* and *B*, we do not know, but that the curve must first ascend and then descend is perfectly evident. This curve teaches that if we have a condition of ventilation as at *D*, an increase in the ventilation to *E* will produce a more favorable condition for a temperature rise. On the other hand, if the original condition is as at *F* and we increase the ventilation to *G*, we can expect a reduction of temperature. Since we have no means of knowing just what the ventilation is in any given portion of a pile, there is great hesitancy in advocating ventilating schemes for coal piles, as we are as likely to make trouble as to prevent it unless extreme and uniform ventilation is assured.

The curves shown have illustrated the tendencies of what are believed to be the principal factors in the problem of spontaneous combustion.

There are many more minor factors. One of the troubles has been that undue attention has often been given to minor factors, such as sulphur, height of pile, volatile matter, etc., while main factors, such as initial temperature, breakage in handling, freshness of coal and coal screening before storage, have been overlooked or minimized.

On account of the unusual demand for electric energy, due in part to coal shortage, the Societa Adriatica di Elettricita and the Societa del Cellina in the territory of Treviso, Italy, are working to transform their plants and increase their production from 28,000 hp. to 280,000 hp. When completed, the plants will be able to dispose of 700,000,000 kw. of energy compared with 32,000,000 kw. at present, which would mean a saving for Italy of about 1,000,000 metric tons of coal per annum.—*Commerce Reports.*

Thirty-ninth Annual Convention New England Water Works Association

The New England Water Works Association held its 39th annual convention Sept. 7-10 at Holyoke, Mass. Hotel Nontuck was the official headquarters, and the business and professional sessions were held in the City Hall auditorium, President Henry V. Macksey presiding.

The fame of Holyoke as a center of development and practice of hydraulic engineering and an attractive convention program of professional papers and entertainments contributed to the encouragement of attendance of over 300 members and guests to one of the most successful conventions ever held by this association.

A paper entitled "The Holyoke Water Works and Its Rainfall and Stream Flow," presented by Patrick J. Lucey, gave a good technical description of the local water works and was especially appreciated by those who were desirous of inspecting the plant during their presence in the convention city.

At Tuesday evening's session, Col. Charles R. Gow read a paper entitled "Experiences with Quicksand," which was well illustrated by lantern slides showing how troubles from so-called "quicksand" may be avoided by diversion of ground water from excavations.

The final report of the Committee on Charges for Private Fire Protection was received and approved to the effect that such protection is a valuable special service for which water companies should be compensated.

Pumping Engineering

Wednesday morning's session was opened by the reading of a paper on "Further Tests of a Unaflow Pumping Engine," by D. A. Decrow, who stated that more recent tests than those previously reported by him gave a steam consumption of 11.4 lb. per i.hp.-hr. operating condensing. In commenting on this paper, the president took occasion to express regret that the association had never specialized on pumping engineering and thought that a determined effort should be made to get more pumping engineers into the association. The president made an earnest appeal to the members to solicit membership of this class of men, of whom he declared the association was much in need.

The Dexter Brackett Memorial Medal for the best paper of the year 1919 was awarded to Robert E. Horton, of Albany, N. Y., for excellence of his paper presented on "Measurements of Rainfall and Snow."

A paper entitled "Loss of Head in a 12-in. Gate in a 16-in. Pipe," by Thomas E. Lally, described experiments made by the water department of Boston, Mass. Discussion brought out the fact—not generally appreciated by laymen—that the obstruction to flow offered by gate valves is so small as compared with loss of head from pipe lines that it is usually practicable to maintain a gate-valve opening equal to 50 per cent of the cross-sectional area of the pipe line.

Operation of Pumping Stations

A paper entitled "Instructions to Employees at Pumping Stations and Filter Plants," by Dow R. Gwinn, described methods of communicating instructions to waterworks employees for maintenance of good discipline and efficient operation of the plants.

A paper presented by Reeves J. Newsom entitled "Modern Pumping Station Design and Operation," described radical changes that had been made for obtaining better plant efficiency for the three pumping stations of Lynn, Mass., water works. The improvements consisted in replacing a low-lift steam-driven pump used only during the winter and spring months by an electric-motor-driven centrifugal equipment installed in a more favorable location for pumping; the replacement of another low-lift unit that consisted of an electric-motor-driven centrifugal by a more modern outfit of superior efficiency; and changing over the main pumping station, which pumps into the mains and equalizing reservoir, from use of coal at present costing about $16.50 per ton to oil-burning at the equivalent of about $9 per ton of coal. The oil-burning installation consists of

a 35,000-gal. storage tank and complete equipment of two 175-hp. boilers.

Whist parties at the Holyoke Country Club and at the Hotel Nontuck and auto rides to Amherst and Smith Colleges and other local points of interest were arranged for the lady guests, and on Thursday afternoon the Water Works Manufacturers Association tendered all members and guests an excursion to Mt. Tom with dinner at the Mountain House and an evening theater party at Mt. Tom Casino.

On Wednesday many members and guests made visits to the works of the International Steam Pump Co. and also to the testing flume of Holyoke Water Power Co. At the latter place the visitors witnessed a test of a 27-in. turbine and were permitted to make inspection of the power measuring apparatus and the complete facilities and appliances for conducting power and efficiency tests of turbine waterwheels.

Industrial Load in California

In order to determine the extent and distribution of the industrial electrical load in California, questionnaires were sent to 1,289 industrial concerns employing fifty or more operatives each. Answers were received from 299 companies which were so distributed among various industries as to give a very definite idea of the industrial power situation. Car shortage, unsettled labor conditions and seasonal variation in illumination requirements were factors tending to lower the output of central stations, but despite these adverse conditions the average daily output gradually increased from 8,832,000 kw.-hr. in January to 9,030,000 kw.-hr. in April.

The survey indicates that the iron and steel industries (including foundries and machine shops), shipbuilding, cement plants, food (including canning and preserving plants), mining, paper mills, chemicals and lumber are the principal manufacturing industries using electrical power. The accompanying table gives data on the utilization of electric power in these industries as well as other industries of less importance.

The Food-Preparation Industry

The food-preparation industry is the most important in California in value of products. There are 316 plants of this general class in the state employing more than fifty operatives each. Reports received indicate that about 21 per cent of the electrical energy used in these factories is generated in private plants and that the amount of energy used in an average factory of this type is in the neighborhood of 221,400 kw.-hr. per annum. In the ninety-six factories reporting, 2,207 motors were installed with a total rating of 32,968 hp. Of the total number of motors 35 per cent are under 5 hp. and the largest is rated at 500 hp. The small motors range between ½ hp. and 1 hp. The usual voltage is 440 and 220 and ranges as high as 2,000. Belt-driven machines total 73 per cent and 22 per cent are direct-connected, the remainder being chain-driven.

The iron and steel industry ranks fourth among the manufacturing industries of the state. There are about 208 plants of this class. In amount of electrical energy used it ranks first among California's industries. Returns received indicate that 31 per cent of the industrial load used in that state is utilized by foundries and machine shops. There are 5,262 motors employed by the sixty companies reporting, with a total installed rating of 81,616 hp. The average rating of the larger motors is between 15 hp. and 20 hp. The usual voltage is 220. More than 63 per cent of the machines are direct connected and 36 per cent are belt-driven.

Shipbuilding an Important Industry

Shipbuilding now ranks among the primary industries of California. The thirteen shipbuilding plants from which reports were received consume 41,116,484 kw.-hr. of electrical energy per year; 1,941 motors are installed by the reporting companies, with a total rating of 46,100 hp. The average rating of the larger motors is between 280 and 290 hp. Nearly 71 per cent of the machines are connected directly to the motors, 28 per cent are belt-driven, while only fourteen chain drives were reported.

Electric drive in stone, clay and glass plants has been generally adopted. One large cement mill reported an annual consumption of 20,866,970 kw.-hr. This plant uses more than 150 motors with a total installed rating of 7,478 hp. Eighty-seven per cent of these machines are belt-driven, and 12 per cent are direct-connected.

Lumbering and lumber manufactures constitute one of California's principal industries. The manufacturing end of this industry is practically all electrically driven at the present time. The logging operations, which could be worked electrically to great advantage, are handicapped in California by the scarcity of power-transmission lines. The thirty-nine lumber companies reporting consumed a total of 7,092,114 kw.-hr. per year of which 51 per cent was generated in private plants. The number of motors used was 1,051, with a total rating of about 17,536 hp. The most widely used motor in the operation of woodworking machinery is the constant-speed squirrel-cage induction motor, and the usual voltage is 440 or 220. The companies reported that 32 per cent of the machines are belt-driven, 17 per cent direct-connected and 5 per cent chain-driven.

A total of 6,272 hp. from hydraulic sources is being obtained by Greek industries. The estimated total available power from waterfalls in Macedonia is 66,000 hp. At present less than one-tenth of the total available power is being utilized, but growing interest is being manifested in the possibilities of harnessing the wasted power.

SUMMARY OF INDUSTRIAL SURVEY FOR CALIFORNIA AS OF JULY 1, 1920

Industry	Number of Companies Reporting	Water Wheels: Number	Water Wheels: Rating, Hp.	Internal Combust'n: Number	Internal Combust'n: Rating, Hp.	Steam Engines: Number	Steam Engines: Rating, Hp.	Steam Turbines: Number	Steam Turbines: Rating, Hp.	Electric Generators D. C.: Number	Electric Generators D. C.: Rating, Hp.	Electric Generators A.C.: Number	Electric Generators A.C.: Rating, Hp.	Energy: Generated, Kw.-Hr.	Energy: Purchased, Kw.-Hr.	Motors Installed: Number	Motors Installed: Rating, Hp.	No. of Drives: Under 5 Hp.	No. of Drives: Belt	No. of Drives: Chain	No. of Drives: Direct or Geared
Iron and steel	60	..	....	2	70	2	205	1	600	2	175	5	570	591,467	59,205,327	5,262	81,616	569	1,873	59	3,267
Motor trucks and accessories	11	..	....	..	....	..	....	..	....	..	....	..	....	....	524,840	130	1,502.5	43	88	1	20
Textiles	23	..	....	..	....	1	55	..	....	3	21.5	..	....	....	207,627	275	2,204	70	151	27	83
Paper	9	1	300	..	....	3	637	..	....	1	65	..	....	....	6,230,760	100	1,672	25	58	....	10
Leather	8	..	....	..	....	..	....	..	....	..	....	..	....	....	137,805	34	250	7	22	2	....
Food	96	..	....	4	1,200	58	5,382	9	2,320	32	1,610	14	3,498	4,386,080	16,867,864	2,207	32,968	784	1,946	137	599
Stone, clay and glass	10	..	....	1	20	4	220	..	....	..	....	..	....	....	38,570,116	257	16,713	29	155	2	55
Mining	4	1	1,300	..	....	..	....	..	....	1	275	1	1,000	897,520	11,742,690	121	7,707	14	23	3	8
Shipbuilding	13	..	....	..	....	..	....	..	....	..	....	..	....	....	41,116,484	1,941	46,099.5	360	516	14	1,285
Electrical equipment	3	..	....	..	....	..	....	..	....	..	....	..	....	....	633,290	288	860	197	92	....	52
Lumber	39	..	....	..	....	37	11,020	13	5,988	11	*435.5	17	5,070	3,619,720	3,472,394	1,051	17,535.5	195	637	5	129
Chemicals	16	..	....	2	40	3	390	..	....	3	112.5	..	....	....	4,314,732	392	6,624.5	81	269	14	62
Miscellaneous	7	..	....	..	....	..	....	..	....	..	....	..	....	....	516,877	283	1,226.5	191	144	7	97
Totals	299	2	1,600	9	1,330	108	17,900	23	8,903	53	2,694.5	37	10,138	9,494,787	183,540,606	12,341	214,979	2,565	5,974	271	5,667

*This is the total of only four of the direct current generators.

Operation of a Modern Gas Producer

A new producer, before being started, should be dried out several days with small fires. This precaution, if properly carried out, will add considerably to the life of the lining. The producer should then be filled to a depth of at least twelve inches over the top of the blower. It is best that a few large clinkers be placed around the openings of the blower to keep them from becoming clogged by the fine ashes. The ashes are necessary to protect the metal parts of the producer and also act as a diffusing medium to distribute the blast over the entire fuel bed, thus insuring even combustion.

To start the producer, it is necessary only to level off the ashes, throw in several armfuls of small dry wood, saturate with kerosene and light with a piece of waste. After the wood was burned for a few minutes, turn on about ten pounds of blast and blow until the wood is burning briskly. A small amount can then be dumped and the fire built up gradually. Care should be taken to see that the coal is not fed too fast. Allow a good bed of coke to be formed before any attempt is made to crowd the producer. It takes several hours to get a producer fire built up properly to where it makes good gas. No special attempt need be made at this point to get the fire distributed over the fuel bed. It will spread itself, and it is better to have a good fire burning at one place than to have several small ones. In case it is necessary to stop the producer at any time, the blast should be turned off.

The various zones of the producer are three in number. They consist of the ash, the incandescent or fire zone and the green-coal zone. The last consists of the coal that has received unsufficient air to become incandescent. This is also termed the distillation zone. The existence of these three distinct zones is a point often overlooked.

In measuring the fires, it is usual to determine merely the distance from fuel bed to producer top. This method is wholly inadequate because no attention is given to the depth of the fire zone, which is the most important point of all in producer operation. If the ash zone exceeds a reasonable limit, the fire zone is reduced. The tendency of the ashes to crowd out the fire zone makes it possible for the top of the fuel to be at the proper height, and yet the fire may be so thin that the gas will be of exceedingly poor quality. The depth of the ash bed, as well as the distance between the top of the fire zone and producer top, should be measured.

Some coals have a tendency to become soft and pasty under the action of the heat in the producer. This restricts the passage of the gas and, owing to the fact that this pressure accumulates under the steady blast, the gases will seek channels to break through the resistance of the fuel bed. These places become excessively hot, melting the ashes and other foreign particles in the coal, resulting in the formation of clinkers. If the coal is of this nature, close attention must be given to the poking and the regulating of the blast. It may be necessary to change the mixture of the blast, increasing the percentage of steam. The increased steam will lower the temperature of the fire and thus considerably reduce the clinkering tendencies of the coal. It should not be carried to the point where the CO_2 content of the gases becomes excessive. This entails a certain loss, but often the trouble due to clinkering more than offsets the loss due to maintaining a lower CO_2.

It is not necessary to discontinue the operation of the producer during the cleaning process. The fire should never be lowered more than eight to ten inches during one cleaning period, and coal should be dumped as during the regular period, although in smaller amounts. The blast pressure should be lowered. During the cleaning period attention should be given to the clinkers that often form on the side walls.

The proper dumping of the coal has an important influence on the operation. It should be dumped in as small quantities as can be arranged. Strict attention should be paid to the color of the gases, which shows whether the fuel bed is of the proper thickness.

In starting a new producer, the top plate has a tendency to run hot and will require all the water that can be applied through the connections. After a few days the plate becomes coated with carbon and a small water supply is needed.

In most installations there are periods when the furnace is down for repairs. This time should be taken to clean the producer completely. The side walls should be cleaned, the blower and blast boxes cleaned out and any part needing attention should now be repaired. This procedure, if carried out, will not entail much labor and the operator will be repaid by increased reliability of the machine.

The quality of producer gas depends upon its combustibles. The quantity and character of these are affected by the operating conditions within the producer. During the ordinary operation of a battery of Wellman producers in a steel mill, 75 tests were made. Briefly stated, the conclusions drawn from the tests were as follows:

To make a rich gas, high in heat units, the ashes should be carried at a height of twelve inches above the blast cover.

The combustion zone should be confined to a thin fire, approximately six to eight inches in thickness.

The green-coal zone, in which distillation by hydrocarbons occurs, should be kept from twelve to eighteen inches thick.

Under these conditions the pressure of the steam used for the blast should be twenty-three pounds per square inch.—*The Blast Furnace and Steel Plant.*

Chemical Society Discusses Water-Supply Problems

The Chicago meeting of the American Chemical Society on Sept. 8 included one session of the Division of Water, Sewage and Sanitation. At these meetings A. H. Behrman reported on lime softening of water for the manufacture of raw-water ice. This report pointed out a large increase in the manufacture of raw-water ice, which in many cases is superseding the use of distilled water for this work.

W. D. Collins presented a paper on "Hardness of Surface Waters in the United States." He presented a tabular summary of typical analyses of waters for various states, or districts within states. This table gives the total solids and the hardness of the water typical of these regions, summarizing the results of the United States Geological Survey studies for a large number of years. These data are not immediately available for publication, but information on particular districts can be secured from the Geological Survey offices in Washington if immediately needed. Other papers presented at this session were by Harry E. Jordon, on "Specifications for Glassware for Water-Works Laboratories," and by Edward Bartow, describing "The New Sewage Station of the Illinois State Water Survey Division."

National Convention of Steam and Operating Engineers

Four hundred delegates, representing as many local unions in the United States and Canada, attended the opening sessions of the Seventh Biennial Convention of the International Union of Steam and Operating Engineers at the Fort Pitt and William Penn Hotels, Pittsburgh, Pa., during the week beginning Sept. 13. Owing to the fact that another convention was scheduled at the Fort Pitt Hotel, the sessions of Tuesday and Wednesday were held at the William Penn.

Addresses of welcome and reports of various committees were heard at the opening session. Among those who addressed the delegates were the Mayor of Pittsburgh, E. V. Babcock, who presented the "key" to the city to the engineers; County Commissioner A. C. Gumbert; W. K. Heck, president of the Pittsburgh Central Union; and Harry Sadler, business manager of the Steam Engineers' Union at Pittsburgh. Milton Snelling, general president of the International Union, presided.

The afternoon session, during which the Hon. John Herron, president of the Pittsburgh City Council and the Hon. William J. Brennen, laborers' attorney, were to deliver addresses, was postponed and merged into the Tuesday morning business session at the William Penn.

Routine business was transacted at the Tuesday sessions. The afternoon session was adjourned at 3:30 o'clock, and the delegates and their friends were taken on an automobile drive and sight-seeing trip to points of interest in Pittsburgh and vicinity in machines provided for that purpose by the entertainment committee.

During the Wednesday morning session convention business was discussed, and in the afternoon there was an excursion and sight-seeing trip down the Ohio River. Music and dancing became the order of the day, and refreshments were served. Convention business was forgotten and everyone had a jolly time.

On the afternoon of Thursday, Sept. 16, there was a theater party for the ladies at the Davis Theater, and in the evening the men enjoyed a stag entertainment at the Moose Temple.

Friday was given over to the closing of convention business and election of officers.

Federated American Engineering Societies Announce Meeting Program

The first meeting of the American Engineering Council of the Federated American Engineering Societies is scheduled to be held Nov. 18 to 20 in Washington, D. C. Headquarters will be at the New Willard Hotel. The program follows:

Thursday Morning Session—Registration; opening session of American Engineering Council; call to order, Richard L. Humphrey, chairman, Joint Conference Committee, consulting engineer, Philadelphia, Pa.; election of temporary chairman; election of temporary secretary; appointment of temporary committees including: program, credentials, constitution and By-Laws, nominations, plan and scope, budget, resolutions.

Thursday Afternoon Session—Address, "Engineering Council," J. Parke Channing, chairman, consulting engineer, New York City.; discussion of the field of activity for the Federated American Engineering Societies.

Friday Morning Session—Report of Committee on Nominations, election of permanent officers, report of Committee on Constitution and By-Laws, formal ratification of constitution and by-laws and report of Committee on Plan and Scope.

Friday Afternoon Session—Report of Committee on Budget and report of Committee on Resolutions.

Friday Evening Session—Introductory remarks by presiding officer, the president of American Engineering Council; address by Herbert C. Hoover, president, American Institute of Mining and Metallurgical Engineers, New York City.; informal reception and smoker.

Saturday Morning Session—Organization meeting of the executive board of the American Engineering Council, of the Federated American Engineering Societies.

French Coal Resources

France consumed before the war over 63,000,000 tons of coal annually, of which she produced, roughly, 42,000,000 tons, leaving 21,000,000 tons to be imported. By the terms of the peace treaty, France acquired control of the Saare Basin, containing coal deposits estimated at 12,500,000,000 tons. Actual production from these coal fields in 1913 was 17,000,000 tons. This new source of coal will take care of the additional demand on France from the industries of Alsace-Lorraine and will lessen the French normal shortage, but will not offset the loss of output in the damaged mines of the departments of Nord and of Pas de Calais.

To make reparation for the damage done to the mines and to other property, Germany was to deliver approximately 25,000,000 tons annually to France for ten years. As a matter of fact, up to May 31 last, France had received only 4,611,000 tons of coal from Germany. However, as a result of the Spa conference held in July France is to receive 1,600,000 tons monthly of the 2,000,000 tons to be delivered to the Allies, beginning Aug. 1. To obtain even these shipments France is obliged to pay Germany 200,000 000 francs monthly for six months for the feeding of the Ruhr workers. But France is doing more than patiently waiting for German coal. She is making every effort to hasten the work of reconstruction in the damaged mines in order to bring their production as soon as possible up to the pre-war figure of 26,000,000 tons. The result of these efforts is shown by the fact that the June output of coal in the two departments of Nord and of Pas de Calais increased 104 per cent and 75 per cent respectively over the previous month.

James Watt Memorial

The James Watt Executive Committee, of Birmingham, England, appointed at a centenary commemoration of James Watt held in England last fall, has collected a part of the £150,000 sterling which it is trying to raise for the purpose of establishing a memorial to perpetuate the name of James Watt. It is the intention to endow a professorship of engineering to be known as the James Watt chair, at the University of Birmingham, for the promotion of research in the principles underlying the production of power.

A memorial volume will be published, and a James Watt Memorial building will be erected to be used as a museum for examples of the work of Watt and his contemporaries, Boulton and Murdock. The building will also serve as a meeting place and library for scientific and technical societies.

Hearings on Boiler Code in California

At the public hearings on the tentative revised boiler safety orders for California, which have been held in San Francisco, objections have been raised by those interested in boiler operation to some of the revisions proposed by the committee appointed by the Industrial Accident Commission of California. A further hearing has been scheduled for October 7 in San Francisco, to continue where that of August 19 left off.

For new installations the commission is at present following the 1914 boiler code of the American Society of Mechanical Engineers, and it proposes to adopt that society's 1918 code to bring makers up to date.

The difficulty arises principally on the proposed code as applied to existing installations. Objections have been filed on the rules that shall apply to calculating the safe working pressure on staybolted surfaces (378,b) and on factors of safety for lap-riveted construction. It is objected that a factor of safety of 4½ should be set as a minimum and let it apply to a boiler regardless of its age, making it higher if conditions of the boiler called for it. Sec. 380,a, proposes from 4¼ to 5 for boilers ranging up to twenty years old, where lap-riveting is employed and the shells are exposed to the direct products of combustion. Where the shells are not so exposed, the commission proposes a factor of from 4 to 5 for the same range, and objectors have recommended the same figure of 4½.

A further factor of safety of 6 is objected to as too high in the case of second-hand stationary lap-seam boilers within the state on Oct. 1, 1920, where both ownership and location have changed (sec. 381,a). It is expected that other objections will be submitted at the Oct. 7 hearing.

The personnel of the boiler-revision committee is quite representative of the interests concerned with boiler operation, and takes its members from gas and electric-power stations, electric railways, machinery dealers' associations, lumber associations, insurance companies, oil companies, operating engineers' unions, the Industrial Accident Commission, iron works, merchants' and manufacturers' associations and a board of public works.

Unsuitable bearing materials and bearings which are not large enough to carry the loads brought upon them are often the cause of heating, and are all the more annoying because they do not readily suggest themselves as the root of the trouble.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Ring, Zelnicker "Ever-Tyte" Piston

Ever Tight Piston Ring Co., 1620 Kingston Ave., St. Louis, Mo.

"Power," August 31, 1920.

This ring is constructed with three parts. The inner or keeper ring, is the width of the ring groove of the piston and is grooved on the outside surface, which groove takes the flanges of the two outside rings. These are held in place by a dowel pin, so that the joints are staggered, thus reducing the amount of leakage past the ring. The construction of the ring forms a right-angle interlock, which closes the point of contact between the number and seals all gaps and compressions, thus preventing waste of power past the ring at any point. This ring is designed for use in internal-combustion engines, ammonia compressors and steam engines.

Pyrometer, Wedge Optical

Rohde Laboratory Supply Co., 17 Madison Ave., New York City.

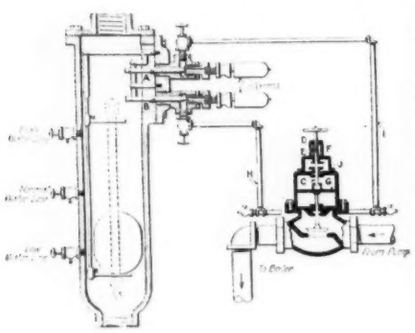
"Power" 1920

This instrument consists of a brass tube, furnished with a small achromatic telescope, so arranged that the objective of the telescope focuses the image of the heated body on a movable prism placed inside the tube. The eye-piece of the telescope then reveals the magnified image on the prism to the observer. A suitable shield is provided to prevent exterior light reaching the the eye. At one side of the tube is a milled head, actuating a rack-and-pinion which moves the prism through the field of vision. The prism is made of dark glass arranged to cut off the light emitted by a heated body at different temperatures. For example, in looking at a heated bar of iron, as the thicker part of the prism comes gradually into the field of vision, the bar appears gradually a darker color, till at a given point the image entirely disappears; this point gives the actual temperature. On looking at the scale on the side of the instrument, the pointer will be seen at (say) 1,000 deg. C. A similar operation takes place in every estimation.

Controller, Kelly Automatic Feed Alarm

Kelly Controller Co., 175 West Jackson Boulevard, Chicago, Ill.

"Power," July 13, 1920.



This feed-water controller is designed for intermittent or continuous feed and is combined with a safety water column having high- and low-water alarm. It also acts as a pump governor. A float operates the alarms and indirectly controls the position of the feed-water valves. When the water rises to the high-water line, the float opens and comes in contact with a stop and opens a needle valve. A slot in the stem of another valve allows it to remain closed.

Combustion Control, Carrick Graduated

Carrick Engineering Co., Chicago.

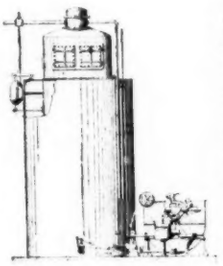
"Power," May 11, 1920.

This device is designed to meet the requirements of automatic control so as to graduate over a predetermined range and to hold the damper in a floating position; that is, in a definite position or a definite set of conditions and move the damper to a new position for a change in any of the variables, such as flow of steam, feed-water supply or furnace condition, the coal feed and air supply being changed simultaneously. Owing to a graduated movement it takes and holds any intermediate position that is required for the load carried and moves to a new position if there is a slight change in the load or steam flow or in furnace condition. The system is designed to maintain the proper relation between fuel and air supplied by individual control on the stoker engines or motors.

Softener, International "Hot-Flow"

International Filter Co., Chicago, Ill.

"Power," June 22, 1920.

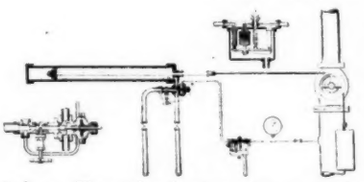


This water softener is made with two chambers of equal holding capacity and an open-type exhaust-steam feed-water heater which is placed on top of the softener. Water flows from the heater to a series of cast-iron trays, and the entering exhaust steam after passing through an oil separater comes in contact with the finely divided water. Hydrated lime and soda ash is fed to the water from a chemical mixing tank and feeder. A float controlled by a change of water level in the float control moves a cutoff shield over the collector funnel in the chemical tank so that at any rate of operation the proper proportion of chemical mixture is admitted to the water. The softeners are made in capacity per hour ranging from 900 to 1,800 gallons. Special sizes capable of taking care of 10,000 boiler horsepower are built.

Regulator, Area Pressure and Temperature

American Gaico, Inc., Grand Central Palace, New York City

"Power," July 27, 1920.



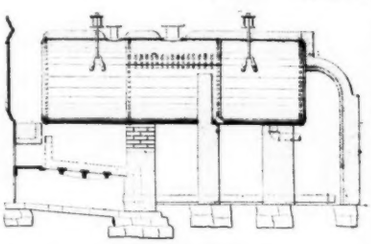
This regulator depends for its operation upon water under a reasonably constant pressure between 15 and 90 lb. It operates a globe valve of the usual type, by means of a sprocket and chain. The valve is opened in one direction by a piston sliding in a cylinder to which water is admitted by a piston valve. The valve is closed by a weight when the water is released from the cylinder. The operation depends upon a relay, which is extremely sensitive and produces close regulation regardless of the fluctuations on the high-pressure side or the variations and the demand of the steam on the low-pressure side.

If the pressure drops on the low-pressure side of the valve, a spring moves the arm and disc toward a nozzle which reduces the flow of the water from the nozzle and thus causes the pressure to build up under a diaphragm, thereby moving a valve piston and admitting water to the cylinder.

Furnace, Preheated Air

I. W. Foltz, Jackson Blvd., Chicago, Ill.

"Power," August 10, 1920.

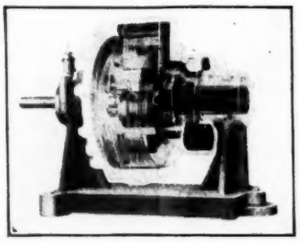


Air is admitted to the ashpit as usual, and much of it passes up through the fuel bed. A portion of this air, 10 to 18 per cent, depending upon the resistance of the fuel bed, passes through an airtight channel embedded in the floor of the combustion chamber. The entrance is at the face of the bridge wall, if conditions are favorable, or in the side wall farther forward in the ashpit. The duct then comes out into the combustion chamber floor back of the bridge wall, passes to the rear of the setting, returns by way of the bridge wall into the side wall, and then passes forward and out over the fire near the front of the furnace. A duct of this character made up of firebrick or tile and high-temperature cement, is placed on either side of the furnace. The air is heated to 750 degrees.

Pump, Crescent Roto-Piston

Crescent Sales and Engineering Co., Detroit, Mich.

"Power," 1920.



The pump consists of two cylinders, one, the roto-piston, being inclosed in the other and touching it at only one point, as they are mounted on different axes. The inner one is revolved at the same angular speed as the outer by cranks connecting the two cylinder heads. The throw of the cranks allows the roto-piston to maintain contact with the outer case in an apparently eccentric motion, which is balanced. This crescent working chamber remains fixed in revolution; the cylinders roll past it and the vane moves with them, displacing the space, although the motion is rotary and continuous. It has a sliding area of a little over one inch on the outer case. The pumps weigh 150 lb., although guaranteed for ½ in. of the barometer or 15 or more pounds to the square inch.

New Publications

HANDBOOK FOR HEATING AND VENTILATING ENGINEERS. By J. D. Hoffman, M.E., Professor of Practical Mechanics, Perdue University. Published by McGraw-Hill Book Co., Inc., New York City. Fourth edition. 478 pages, 201 illustrations. Price $4.50.

In this handbook of heating and ventilating the author has compiled the essential data required by the student of heating and ventilating. The volume is in the main devoted to descriptions of the various systems of heating, etc. This matter, along with the computations given, should be of benefit to the engineer as well as the student.

ACCOUNTS IN THEORY AND PRACTICE. By Earl A. Saliers, assistant professor of accounting in the Sheffield Scientific School of Yale University. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York City. Cloth, 9 x 6 in.; 301 pages.

The purpose of this book is to afford a first course in the principles of accounts. An attempt has been made to work out an effective combination of theoretical discussion and practical application. The material is so arranged that, if desirable, the order of study may be varied and some parts may be omitted. For reference purposes a bibliography has been inserted at the end of each of the six parts of the book. To facilitate review work an appendix containing a series of questions on each chapter has been added. The six parts of the book consist of: Fundamental principles of accounting, partnership accounting, expansion of accounting records, corporation accounting, financial statements, and special application of principles.

Personals

C. O. Foss, St. John, N. B., Canada, has been appointed a member of the Hydroelectric Commission of New Brunswick.

Edmond S. Turner has joined the engineering department as estimator of the Pacific Power and Light Co., Portland, Ore.

Cloyd M. Chapman has severed his connection with Dwight P. Robinson & Co., Inc., and opened an office at 171 Madison Ave., New York City, as a consulting engineer.

Dr. Arthur M. Buswell has been appointed chief of the Illinois State Water Survey, Urbana, succeeding Dr. Edward Bartow. Dr. Bartow has left this work to become head of the Chemistry Department at the Univerisity of Iowa, Iowa City. Dr. Buswell comes to this work from Columbia University, where he has been engaged in teaching and investigational work in the Department of Sanitary Engineering.

Society Affairs

A Chicago Section of the American Welding Society was organized at a meeting of members of the welding trade in Chicago on Aug. 3. The secretary-treasurer of the new section is L. B. Mackenzie, 608 South Dearborn St.

The Ninth Annual Safety Congress of the National Safety Council will be held at Milwaukee, Wis., Sept. 27. to Oct. 1. The meetings and exhibit will be held at the Milwaukee Auditorium, and the convention headquarters will be at the Hotel Wisconsin.

The American Institute of Electrical Engineers will meet in Chicago on Nov. 12, under the auspices of the Protective Devices Committee. D. W. Roper, chairman of the committee, will read a paper on "Lightning Protection."

The Michigan Section of the National Electric Light Association, selected at the recent annual convention at Ottawa Beach the following members to the executive committee: W. M. Lewis, Muskegon; H. A. Fee, Adrian; S. B. Tuell, Houghton; R. E. Keller, Kalamazoo; and B. E. Waltz, Ludington.

The American Institute of Electrical Engineers will hold its first regular fall meeting in Philadelphia, Oct. 8. Two papers will be presented, as follows: "Economic Study of Secondary Distribution," by P. O. Reyneau and H. P. Seelye, Detroit Edison Co.; and "Electrical Demand Measurements," by P. A. Borden, Ontario Power Commission.

The American Electric Railway Association will hold its thirty-ninth annual convention at Atlantic City, Oct. 11 to 15. "Problems of Fuel Supply" will be the subject of an address by Eugene McAuliffe, president of the Union Colliery Co., St. Louis, and formerly manager of the Fuel Conservation Section of the United States Railroad Administration.

A Committee on Hydraulic Research has been appointed by Engineering Foundation. This committee will endeavor to formulate problems to which it may be possible for Engineering Foundation to devote some of its efforts. It will also collect information about existing hydraulic laboratories and other places in which hydraulic experiments can be conducted. J. Waldo Smith and S. H. Woodard have consented to serve as the committee.

The American Association of Engineers in efforts to make its employment service more intensive locally and supplementary to its national service, has appointed local employment representatives throughout the country. The eight paid secretaries of the associations in New York, Washington, Pittsburgh, Detroit, Minneapolis and St. Paul, Chicago and Seattle are handling placement services in the territories under their jurisdiction. In addition, 40 of the 150-odd chapters are giving local employment service in conjunction with the service department activities in the national headquarters at Chicago. As a means of determining how such free employment agencies can best serve employers of engineers and engineers themselves, the American Association of Engineers is sponsoring a national convention of free employment representatives to be held in Chicago on Nov. 12. All engineering societies and other agencies maintaining free employment service will be invited to attend this convention and contribute to the discussion expected.

Miscellaneous News

The Dunwoody Institute, Minneapolis, Minn., will conduct a course in boiler-room operation beginning on the evening of Oct. 5. The course, which will cost $6, will consists of 50 lessons, two to be given each week.

The Bureau of Mines is co-operating with the Emergency Fleet Corporation in tests of the Scottish marine boilers. The tests are being conducted at Chester, Pa. One of the objects of this work is to try and obtain results that will be comparable with tests run on the Emergency Fleet Corporation's design of water-cooled boilers.

Business Items

The Mono Corporation of America announces the removal of its main office from Buffalo to 25 West Broadway, New York City, where its complete line of automatic continuously recording gas-analyzing instruments will be displayed.

Trade Catalogs

The Page Boiler Co., of Chicago is issuing a 6-page pamphlet mentioning the possibilities of utilizing waste heat and bringing out the distinctive features of the Page boiler. It contains photographic reproductions of the boiler and of typical waste-heat installations.

The Royal Manufacturing Co., Rahway, N. J., manufacturer of cotton and wool waste, has ready for distribution a 25-page catalog describing the various operations involved in the manufacture of this product. The text is illustrated by photographs. A copy may be obtained upon application.

The Yarnall-Waring Co., Chestnut Hill, Philadelphia, has ready for distribution a new 16-page booklet entitled, "Yarway Blowoff Valves." The text describes the seatless valves manufactured by this company. Illustrations and line drawings are also given. A copy will be sent to anyone interested on request.

New Construction

PROPOSED WORK

Me., Baugot — The Keyes Fibre Co., Waterville, plans to build a 40 ton capacity mill here, electrically operated for grinding wood pulp.

Mass., Cambridge—J. R. Worcester & Co., Archt. and Engr., 79 Milk St., Boston, will soon award the contract for a 1 story, 70 x 400 ft. printing plant addition including a steam heating system on First St., for Ginn & Co., 15 Ashburton Pl., Boston. About $250,000.

Conn., Cromwell—William Suda is in the market for 20 or 30 hp. boiler and engine (used preferred).

Conn., Middletown — The New England Enameling Co., River Rd., plans to build a 1 story power house addition. Westcott & Mapes, Inc., 207 Orange St., Archt. and Engr.

Conn., Waterbury—The Lux Clock Mfg. Co., 105 Sperry St., will soon award the contract for a 4 story, 25 x 105 ft. manufacturing building including a steam heating system on Sperry St. About $50,000.

N. Y., Buffalo—The R. E. Dougan Co., 66 Oak St., is in the market for ½ or ¾ hp. d.c. motor.

N. Y., Buffalo — The Phoenix Beverage Co., 835 Washington St., is in the market for 2 boilers, coal crusher, elevator and conveyor for power house.

N. Y., Jamestown — The city received bids for the installation of heating and plumbing equipment in the Falconer St. School, from James Bresnahan, $24,990; Chatfield & Sharpe, $20,249.

N. Y., Long Island City — The Allied Printing Association of Manhattan, c/o William E. Austin, Archt. and Engr. 46 West 24th St., New York City, is having plans prepared for a 9 story, 80 x 400 ft. printing plant including a steam heating system on Jackson Ave. near Herald St.

N. Y., New York—The Bd. of Welfare received bids for installing a low pressure steam heating system in pavilions B and D, Blackwell's Island, from Collins & Horan, $5,914; Chute, Thornton, Bailey, 2 East 13th St., $5,970; P. J. Larkin & Co., 331 East 55th St., $6,944.

N. Y., Portchester—William H. McElfatrick, Archt. and Engr., 701 7th Ave, will receive bids until Sept. 25 for a theatre including a steam heating system for Ponty & Wein. About $350,000.

N. Y., Rochester—Otto Han, 321 Champlain St., is in the market for a 2 to 3 hp. a.c. motor.

N. Y., Rochester—Tatlock Bros., 183 Tremont St., is in the market for one 50 hp. marine type boiler and 1 closed heater.

N. Y., Yonkers—The Hudson Tire & Rubber Co. is having plans prepared for a 3 story factory and power plant. About $300,000. The Osborn Eng. Co., 2848 Prospect Ave., Archt. and Engr.

N. J., Bayonne—The Tidewater Oil Co., Constable Hook, plans to build a 147 x 150 boiler and pump house. About $86,000.

N. J., Glassboro—The State rejected all bids for the installation of a heating system in the proposed 3 story, 125 x 301 ft. school. Noted Aug. 31.

N. J., Hightstown—The Borough will soon award the contract for building and equipping proposed waterworks pumping station. About $70,000. W. S. Coulter, 114 Liberty St., New York City, Engr.

Pa., Philadelphia—The Benjamin Franklin Hotel, c/o Frederick Weber, Archt., Morris Bldg., is having plans prepared for a 16 story, 194 x 230 ft. hotel including a steam heating system on 9th and Chestnut Sts.

Md., Baltimore—Samuel T. Williams, 223 North Calvert St., is in the market for two 200 to 300 kw., 2,300 volt, 3 phase, 60 cycle, generating units, preferably turbine, water tube boilers, condensers, pumps, etc.

D. C., Washington—The United States Engineer's office is preparing plans for pumping facilities consisting of electrically driven pumps, etc., for the Key Bridge here. About $100,000.

Va., Norfolk—The Office of the City Mgr. will soon award the contract for a dam, pumphouse, and road diversions.

Va., Petersburg—James Posey, Consult. Mechanical Engr., Fidelity Bldg., Baltimore, is preparing plans for a central heating plant consisting of boilers, smokestack, stokers, etc., to all buildings for the Virginia Normal and Industrial Institute. About $100,000.

Va., Richmond—The Richmond Auto Shop, 40 North 18th St., is in the market for motors, etc. J. B. Cullingworth, Purch. Agt.

O., Cleveland—The Belmore Co., c/o M. B. Sharfeld, 206 Society for Savings Buildings plans to build a 20 story, 99 x 300 ft. commercial and office building including a steam heating system on Superior Ave. between East 6th and East 9th Sts. About $5,000,000.

O., Cleveland—S. Bohm, Archt. and Engr., Williamson Bldg., will soon award the contract for a 1 story, 30 x 50 ft. boiler room including two 225 hp. boilers on West 49th St. and Lorain Ave. for the Jacob Laub Baking Co., 4919 Lorain Ave. About $25,000.

O., Cleveland—The Lillian Realty Co., c/o W. B. Cohen and Albert Koblitz, The Arcade, has purchased a site on East 17th St. north of Euclid Ave. and plans to construct an 8 story, 40 x 120 ft. commercial building including a steam heating system on same. About $350,000.

O., Springfield—The Bd. Educ. will soon award the contract for a 3 story, 119 x 138 ft. grade and high school including a steam heating system on B'way. About $300,000. O. D. Howard, 8 East Broad St., Columbus, Archt.

Ind., Indianapolis—The Bd. of School Comrs., Meriden and Ohio Sts., will receive bids until October 1 for heating, ventilating, plumbing and gas fitting, power house installation, boilers, etc., in buildings at the Arsenal Technical Schools. Noted June 15.

Mich., Detroit—The Detroit Public Health Dept., City Service Bldg., plans to build a 3 story hospital including a steam heating system on Taylor Ave. About $3,000,000. A. Kahn, Marquette Bldg., Archt.

Mich., Detroit—Horace H. Lane, Engr., Dime Bank Bldg., will soon award the contract for a 3 story, 128 x 150 ft. warehouse including a steam heating boiler, etc., on Dequindre St., for the Western Electric Co., c/o F. J. Whitney, Kirby Ave. and Dequindre St.

Mich., Monroe—Reed M. Dunbar, Archt., will soon award the contract for a 1 story, 90 x 210 ft. foundry including electric motors for power, for the Monroe Auto Equipment Co., East First St. About $100,000.

Wis., Beaver Dam—The Wisconsin Power Light & Heat Co. plans to build a 60 x 150 ft. power house on Main St. Hutter Constr. Co., 128 Western Ave., Fond du Lac, Engrs.

Wis., Fond du Lac—The City is having plans prepared for a tuberculosis sanatorium near here. Plans include a separate power plant. About $300,000. J. E. Henner, Archt.

Wis., Jefferson—Dan Rees is in the market for artificial ice making machinery.

Wis., West Bend—The Schmidt & Storck Wagon Co., is having plans prepared for a 1 story, 100 x 270 ft. wagon factory including a boiler and power house, etc. on Main St. About $70,000. Bremming & Guth, 521 Jackson St., Milwaukee, Archts.

Ia., Newmarket—The City Clerk will soon receive bids for a deep well pump and pump house, etc. About $36,000. E. T. Archer, Kansas City, Mo., Engr.

Minn., Faribault—The State Bd. of Control, Capitol, St. Paul, received bids for two building additions at the State school including a steam heating system from Edward Bjorklund, 786 Como Blvd., St. Paul, $86,507; H. J. Frandsen, 510 Rice St., St. Paul, $92,000; R. C. Elvin & Co., 852 Plymouth Bldg., Minneapolis, $95,890.

Tex., Ballinger—C. S. Guin plans to build an ice factory. A steam engine and boiler will be installed in same. About $50,000.

Tex., Crockett—The Crockett Brick & Tile Co. is in the market for a 60 hp. boiler and a 50 hp. steam engine. H. A. Fisher, Pres.

Tex., Dallas—The Pure Ice & Cold Storage Co., Manila and Harwood Sts., plans to build an addition to ice factory including equipment for same. About $20,000.

Tex., Dallas—The Rick Warehouse & Stores Co. will receive bids about November 15 for a 10 story, 178 x 321 ft. exposition building including a steam heating system and individual power plant at 2600 Elm St. About $1,000,000. A. C. Rick, Pres.

Tex., Dallas—The School Bd. will receive bids until November 15 for a 3 story high school including a steam heating system on Haskell and McKinney Sts. About $600,000. C. M. Moore, Secy. W. B. Ittner, St. Louis, Mo., Archt.

Tex., Italy—The Watson Gin Co. will soon award the contract for a cotton gin plant including several buildings. A steam boiler, engine etc. will be installed in same. About $30,000.

Tex., San Benito—The San Benito Electric Light & Power Co. plans to build an electric light plant.

Col., Fleming—The Bd. of Trustees will soon receive bids for the construction of a power plant for water and light service. About $50,000.

N. B., Frederickton—The New Brunswick Electric Power Comn. plans to construct earth dams in connection with the development of the power projects at Shogomoc and Musquash. Henry Holgate, 285 Beaver Hall Hill, Montreal, Engr.

Ont., East Sandwich—The city plans an election to vote on $200,000 bonds to construct an intercepting sewer, pumping station and sewage disposal plant. Centrifugal motor driven pumps will be installed in same. Morris Knowles Ltd., Heintzman Bldg., Windsor, Engr.

CONTRACTS AWARDED

Mass., Boston—The Massachusetts Bonding & Insurance Co., 77 State St., has awarded the contract for an 8 story, 90 x 125 ft. office building including a steam heating system on Arlington St., to L. P. Soule & Sons Co., 80 Boylston St., at $500,000.

Mass., Fall River—The Amer. Printing Co., 56 Water St., will build a 1 story, 100 x 119 ft. factory and a 1 story, 44 x 133 ft. power plant on Water St. About $165,000. Work will be done by day labor.

N. H., Manchester—The Bd. Educ. has awarded the contract for the installation of a steam heating system in the Franklyn St. school to the Stone Underhill Co., at $57,094; in the West Side high school to P. A. Dolan, 237 B'way, Boston, at $89,998; and in the Practical Arts high school to John H. Stevens, at $139,017. Noted Aug. 17.

N. Y., Buffalo—The Buffalo General Electric Co., Electric Bldg., will build an electric distributing station. About $7,500. Work will be done by day labor.

N. Y., Buffalo—The city will build a 1 story, 26 x 50 ft. addition to power plant at 835 Washington St. About $15,000. Work will be done by day labor.

N. Y., Buffalo—The Rome Wire Co., Clyde Ave., will build a 1 story, 50 x 80 ft. power house. About $15,000. Work will be done by day labor.

N. Y., New York—The Bronx Society for Prevention of Cruelty to Children, 355 East 137th St., has awarded the contract for a 7 story, 96 x 135 ft. home including a steam heating system on Park Ave. and 16th St., to Niewenhons Bros., 316 East 161st St. About $350,000.

N. Y., New York—The Standard Oil Co. of New York, 26 B'way, has awarded the contract for the 5 story extension to office and a 12 story addition at 18 B'way, to C. T. Mills, 286 5th Ave.

N. J., Bridgeton—The Illinois Glass Co. has awarded the contract for a group of buildings, including a 3 story, 330 x 700 ft. main plant, 2 units, 50 x 150 ft. producer building and a 2 story, 50 x 100 ft. engine and boiler room on North Laurel St., to the Keeley Bros. Constr. Co., 507 Federal St., Camden, at $3,000,000.

N. J., Trenton—The Cook Linoleum Co., East State St., has awarded the contract for a 1 story, 72 x 140 ft. boiler house, to the J. H. Morris Co., Broad St. Bank Bldg., at $100,000. Four boilers, etc., will be installed in same.

N. J., Hoboken—The Bd. Educ. has awarded the contract for installing a heating and ventilating system in the proposed school 2, to J. A. Cooney, at $112,494.

Pa., Marcus Hook—The Viscose Co. has awarded the contract for a 3 story, 60 x 110 ft. boiler house, to H. L. Morris, Chester. Noted April 20.

Pa., Philadelphia—The Pennsylvania R. R., Broad and Market Sts., has awarded the contract for a 1 story, 320 x 32 ft. sub-station on 30th and South Sts., to Fred A. Havens, 845 North 19th St., at $38,000.

Ill., Chicago—The Lawrence Ice Cream Co., West 21st St., has awarded the contract for a 2 story, 219 x 250 ft. ice cream factory including a boiler room, to E. F. Weigel, 1624 West 63rd St.

O., Cleveland—The Variety Iron & Steel Co., East 40th St. and Hamilton Ave., has awarded the contract for a 1 story, 21 x 77 ft. power house, to the Hunkin-Conkey Constr. Co., Century Bldg., at $10,000.

Pa., Philadelphia—The Ferguson Carpet Co., Rockland and Stenton Sts., has awarded the contract for a 1 story, 40 x 74 ft. power house including equipment, to Fred A. Havens & Co., 845 North 19th St.

Tex., Corsicana—The Central Texas Grocery Co. will build a cold storage plant. About $20,000.

Ont., Toronto—The J. A. Harrison Coal Co., Ltd., 57 Brock Ave., has awarded the contract for a coal elevating and storage plant to J. B. Nicholson & Co., 36 Toronto St., at $35,000. Electrically operated elevating machinery will be installed.

Ont., Ottawa—The Famous Players Film Co., Temple Bldg., has awarded the contract for a 1 and 2 story motion picture theatre including a vacuum steam heating and mechanical ventilation system to the Atlas Constr. Co., Ltd., 37 Belmont St., Montreal. About $350,000.

See Pages 96 to 112 **Need Competent Help?** See Pages 96 to 112